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The Demand for Selected Deciduous Tree Fruits With Implications for Alternative 1980 Production Levels

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HIGHLIGHTS OF REPORT

1. Water development projects in California now provide for the potential development of irrigation agriculture on large acreages on the West Side of the San Joaquin Valley. A problem facing producers is the selection of crops that are economically feasible due to the relatively high cost of water. This study focuses on the demand for five fruit crops that may be produced in this area; namely, apricots, freestone peaches, clingstone peaches, plums and nectarines. Demand projections are given for 1980, with implications as to the required acreage needed to meet this projected demand with given yields in 1980 and for alternative price and production conditions.

2. California produces about 100 percent of the United States' output of clingstone peaches and nectarines, 95 percent of apricot production, 90 percent of plum production, and 25-30 percent of freestone peach production. Changes in production levels in California will have a major impact on price and the profitability of fruit production. It, therefore, is important to have estimates of the price elasticity of demand for these fruit crops by major outlet such as canning, fresh, frozen, and dried. Also, it is important to have estimates of demand elasticities for processed fruit products sold in export and domestic markets. A major portion of this study is concerned with such estimates.

3. At the farm level, this study indicates the inelastic nature of demand for major outlets. This means that if price is decreased by 10 percent, consumption will increase by less than 10 percent, resulting in a total reduction in gross income for the industry. The total demand for these fruits will increase over time due to population growth and generally positive income effects. The important question is how much increase in production can be absorbed in the market without price decreases.

4. Estimates are provided for 1980 as to the shift in the demand curve due to population, income, and trend. Assuming prices to remain at 1961-65 levels, we obtain estimates of the production required

to meet this level of consumption. Next, estimates of the expected yield per acre in 1980 are used to determine the associated bearing acreage required for the production level. A reduction in bearing acreage is indicated for apricots and freestone peaches, and modest increases are obtained by this calculation for clingstone peaches, nectarines, and plums. If production is higher than estimated under the above assumption, prices are lower and bearing acreage, naturally, is higher.

5. It is expected that the acreage of deciduous tree fruits, especially those included in this study, will continue to shift to the San Joaquin Valley. Thus, some expansion of acreage in the area is for replacement of orchards in urbanizing areas. This analysis indicates the limited net expansion possibilities for these fruit crops to 1980 if prices are to be maintained. Individual producers thus should keep in mind the market implications of increased production levels in estimating the expected profitability of these crops over the productive life of the orchard.

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THE DEMAND FOR SELECTED DECIDUOUS TREE FRUITS WITH IMPLICATIONS FOR ALTERNATIVE 1980 PRODUCTION LEVELS

by

Ergun Kip and Gordon A. King*

INTRODUCTION

Economic Adjustments with Resource Development

The development of new supplies of irrigation water will force a series of changes and adjustments in California agriculture. This is the situation for the West Side of the San Joaquin Valley, an area which will soon supplement its limited local irrigation water supplies with a large volume of water transferred from the Northern parts of the State through the California State Water Project and the Federal San Luis Project. The San Joaquin Valley West Side is one of a few large areas of relatively undeveloped high quality irrigable land remaining in the climatic zones that potentially can produce the citrus and deciduous fruits and the vines and truck crops that have long enriched the California economy.

The production potential of the West Side is considerable. The water to be imported (approximately 2.5 million acre-feet) is adequate for tremendous crop expansion and the soil and climatic situation is extremely favorable for a highly varied and intensive pattern of crop production. It is expected that within the next few years there will be a gradual reorientation and adjustment in the West Side agriculture. Imported water is expensive. Thus, it is a common consensus that a shift will take place from less intensive field crops to more intensive and high-value field, vegetable, and orchard crops. Citrus (especially oranges), almonds, and deciduous tree fruits are the most likely orchard crops to come to the West Side. Among the deciduous tree fruits, apricots, clingstone and freestone peaches, nectarines, and plums are considered to be the best adaptable crops to the West Side conditions. The economic feasibility of their production in the West Side is investigated in this study.

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Increased irrigation water supplies and the resulting adjustments in such dimensions as farm size and organization, resource use, and cropping patterns in the West Side cannot take place in isolation from other areas or regions either in California or other parts of the United States. California producers in general, and the San Joaquin Valley producers in particular, compete with producers in other locations, through the factor and product markets, in fulfilling demands for these products.

Traditionally, irrigation development projects have been regarded primarily as an engineering problem. Economic and social implications have been viewed in terms of local areas and economies with inadequate attention given to effects of project development beyond the Project boundaries. From a local point of view the supply of water to a number of farms is the actual service rendered by the State and/or Federal Government when it constructs an irrigation project and thus the benefits and costs of the water development project are evaluated from this point of view. This point is best explained by Huffman [1953, p. 3]:

> "New irrigation projects are a sort of frontier, and for many years, like other frontiers, they developed without much consideration of the economic and social problems involved. Historically, the development of new irrigation projects has been considered as a problem of concern primarily to the engineers who build them and to the individuals who settle on the farm units. Agricultural aspects of the total development problem were largely overshadowed by the engineering work involved, and the success of irrigation projects was too often measured in terms of the magnitude of the engineering obstacles overcome."

In a highly developed exchange economy in which the competition among regions and sectors for resources and profitable production of commodities are the most vital elements, an irrigation project should no longer be considered solely in terms of the local economy and the engineering problems it raises. Excluding probably the most important problem of physical conditions, profitable agriculture in an area or region also depends importantly upon economic and governmental-institutional conditions.

In the case of the San Joaquin Valley West Side, "present evidence indicates that economic forces and governmental policies will largely regulate cropping systems and how agriculture develops in the dry lands on the West Side. The huge quantities of new water are necessary but not sufficient for profitable farm expansion" [Hedges, 1967, p. 3].

Production of various crops can be increased considerably as long as governmental restrictions on production and resource use permit. Cotton allotment programs can limit production, and acreage limitations on farm size for Federal water projects do affect resource use. But what will be the price effects of increased production either on the West Side or in other competing areas in California or in other states? The market demand for these crops is the major focus of this study.

Specific Objectives of this Study

As mentioned previously, the five deciduous fruits of apricots, clingstone peaches, freestone peaches, nectarines, and plums culturally are suited for production in various parts of the San Joaquin Valley. There is a need, however, to assess the effect of introduction of increased production of these fruits on market price and, thus, on established production areas in the State.

The first objective of this study is to estimate the demand for these fruits. The model is complicated by the multi-market outlets for the fruit sold from ranches, and the domestic and export demand for processed fruit.

The second objective is to project the demand to 1980. Simplified relationships are presented to emphasize the expected increase in production that can be sold at alternative prices consistent with 1980 demand levels associated with increased per capita income, population growth, and changing consumer preferences.

The third objective is to estimate bearing acreage consistent with 1980 production and price assumptions. For the State, yields are projected to 1980 and bearing acreages consistent with demand levels for 1980 are calculated. For major producing regions in the State, estimates are made of the probable regional distribution of production, allowing for shifts to the Valley due to pressures on land urbanization in some regions.

From the above estimates, it becomes apparent the extent to which acreage on the West Side of the San Joaquin Valley can be introduced without important price-depressing effects on total California production.

Outline of Report

The next section provides a description of the agricultural developments in the San Joaquin Valley, and the problems involved in evaluating the economic feasibility of production alternatives. It points out that the present study is of limited scope, dealing with only five orchard crop alternatives. The next two sections deal with the technical aspects of estimating the demand relationships for these five fruits. The following section makes use of certain of these demand relationships in tracing through the economic implications of alternative production levels for 1980 demand conditions. This last section should be of particular interest to those concerned with the implications of production of the West Side on State production, prices, and incomes.

SAN JOAQUIN VALLEY WEST SIDE AGRICULTURE

General Description of the Area

Farrell [1969] provides a concise description of the importance of the area:

> "The counties of Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and Kern, called the San Joaquin Valley,[1] comprise one of the richest agricultural areas of the world. Embracing an area of 16.6 million acres, 17 percent of the land area of California, the Valley includes 31 percent of all farms and 29 percent of the land area in farms in California. The value of farm products sold by Valley farmers in 1964 totaled slightly more than $1.3 billion, or 38 percent of the total value of such products sold in the State."

The West Side of the San Joaquin Valley is a loosely defined area often thought of as a remote section of the Valley because the physical-economic axis of the Valley is along Highway 99 and the Southern Pacific Railroad. The West Side is generally characterized by large corporate farms, mechanized cotton production, and the oil fields [Marr, 1966]. According to one definition, this area extends some 175 miles from San Luis Dam near Los Banos to the Tehachapi Mountains south of Bakersfield and has an average width of 25 miles along the western side of the Valley floor. Geologically the area consists of a group of coalescing alluvial fans built up from deposits washed out of the coast ranges to the west. In summary, the West Side is bounded by the coast ranges to the west, by the Sacramento-San Joaquin Delta to the north, by the trough of the San Joaquin Valley to the east (roughly the San Joaquin River or Fresno slough), and by the old drainages of Tulare Lake and Buena Vista Lake to the south. Sparsely populated and arid, the region is now only partially irrigated by deep wells which are steadily exhausting the ground water resources [Todd, 1966, p. 3].

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[1] The County of San Joaquin frequently included in the San Joaquin Valley, is not included here in order to conform more closely with hydrologic study areas defined by the California Department of Water Resources [1967d].

San Joaquin Valley West Side represents approximately one and one-half million acres. Currently about 600,000 acres are not irrigated at all. Hedges [1967, p. 29] provides the following evaluation of the area:

> "Approximately another 440,000 in the western side of Kern County receive a part of the amount of water required to make full irrigation possible. Another 450,000 or so acres in western Fresno County, in terms of effective irrigated agriculture, gets about a third of the water necessary to operate on an optimum resource use under irrigated agriculture. In that particular situation, both cost and quantity now limit agricultural practices and crop choices. Cotton, essentially, is the only crop with a broad major market that farmers can depend on under current practices and yields to assure that irrigation is profitable.[1/] A limited number of acres can be put in alternative crops to enter the narrower market areas for individual specialty crops, cantaloups, and certain other annual crops are in this category. The quantities of water that now are available represent about a third of what could be used. These quantities tend to reduce from year to year, as well as to rise in cost, because this water comes from deep wells. As time goes on, water pumped is not being replenished."

The increase in irrigation developments would encourage changes in cropping patterns in favor of higher value per acre crops such as vegetables, fruits, nuts, and cotton.

Thus, the value and volume of crop production in the area are expected to increase as a result of several factors: (1) a continued shift from dry land to irrigated crop production and accompanying shifts in crop production patterns; (2) the use of more land for production

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[1/] The future profitability of cotton will depend on government support programs. Cotton, at present, is facing strong competition in the domestic market from man-made fibers and in export markets from other cotton producing regions.

purposes as water for irrigation becomes available through Federal and State water projects; and (3) higher yields per acre resulting from more extensive and effective application of known technology, as well as the development and application of new technology.

It is difficult, for several reasons, to estimate the additional new land which might be brought under cultivation in the San Joaquin Valley in general and the West Side in particular [Farrell, 1969]. First, the production capability of currently noncultivated land, particularly on the West Side, has not been thoroughly assessed. Second, the extent to which bioclimatological characteristics may limit production of crops on undeveloped lands is not well established. Finally, development and production costs for currently uncultivated land, relative to expected returns from alternative crops, have not been adequately examined.

As far as scale and type of farming is concerned, size of farm increases from north to south in the West Side and from east to west within each county. Starting in the north, the natural surface-obtained water supplies are associated with small, intensive type agricultural development but relatively small ownership patterns. Farther south, the large corporate ownership pattern emerges. Generally, then, field crops such as feed grains, cotton, and alfalfa assume progressively greater importance from north to south.

Present Water Resources

The West Side of the San Joaquin Valley is an area of generally deficient water supply. Rainfall is meager and the tributary streams carry little water. The southwestern part of the Valley, from Avenal south to Maricopa, is a desert. It is largely uncultivated and is used chiefly for grazing. Western Fresno and Kings Counties constitute an area of very heavy overdraft on ground-water supplies. Water levels in the confined aquifers have been drawn down rapidly in response to this heavy overdraft. The seasonal fluctuations register variations in pumping of ground water, but the year-to-year trends have been consistently downward. Movement of ground-water is generally westward across the axis of the Valley to this area of heavy withdrawals.

Much of western Merced, Stanislaus, and San Joaquin Counties is irrigated by water diverted from the San Joaquin River. These areas of surface supply are generally more than adequately watered, and water levels accordingly stand near the land surface. Both seasonal and long-term fluctuations are small. Movement of ground water is toward natural drains that intersect the water table and westward to areas along the Valley border that are irrigated with ground water.

The present West Side water problem focuses on the limited supplies and high costs. Total pumpings are very large and even though some of this water percolates back to restore ground-water supplies, the net overdraft is still substantial in a given year. On the basis of some data relating to the total pumpings and net overdraft, Caton, Hedges, and Schaller [1958] conclude that:

> ". . . the agriculture on the West Side will be of limited duration unless replacement water is obtained. Thus, the ultimate solution to the West Side water problem is to obtain additional water from new sources. If farmers are unable to accomplish this, costs will force them to abandon present farming methods, based on using large amounts of water to produce summer crops."

Limited supplies of underground water is the general problem encountered throughout the West Side. On the other hand, West Side farmers have a more serious and acute current problem. This is the depth to underground water supplies, and consequent long lifts to get this water to the surface. The estimated overall lift in the Mendota-Huron area in 1951 was 400 feet [Davis, *et al.*, 1954]. In a more recent study [Moore and Hedges, 1962], it is indicated that with continuous pumping, the water level has dropped further; it is likely that the lift now averages about 500 feet. Even if the water level has not dropped further since 1962, cost per acre-foot for irrigation water is high. Moore and Hedges [1962] estimated the average total pumping costs (fixed plus variable) per acre-foot of water by hydrographic areas in the San Joaquin Valley. A brief summary of these findings is given in Table 1. The highest costs of pumping per acre-foot of water are on the West Side.

TABLE 1

Typical Costs of Pumping Water, San Joaquin Valley, 1949-54

County	Low Cost Area		High Cost Area	
	Modal pump lift	Total cost per acre-foot	Modal pump lift	Total cost per acre-foot
	feet	dollars	feet	dollars
Stanislaus and Merced	25- 49.9	2.39	50- 74.9	3.78
Madera	50- 74.9	3.66	75- 99.9	4.82
Fresno	25- 49.9	2.76	400-449.9	22.64
Tulare	25- 49.9	2.76	150-174.9	13.99
Kings	25- 49.9	2.76	400-449.9	22.64
Kern	125-149.9	10.52	300-349.9	17.83

Source: Moore and Hedges [1962].

Because of the high cost of obtaining underground water, it is a common practice in the West Side to consider a section of land as the basic production planning unit and at the same time to drill one well per section of land. In order to economically justify a heavy investment in drilling a well and establishing an irrigation system, it is thought that a crop rotation should be established on at least an area of one section. The water problems of growers on the West Side is best explained by Caton, Hedges, and Schaller [1958] as follows:

> ". . . under ideal conditions a grower could expect with one such well, representing an initial investment of $25,000 or more, to provide adequate water for about a quarter section (160 acres) in summer crops, and the remaining three quarters of his land in barley, produced during the winter months. He expects to operate his well most of the year--9 to 10 months--and thereby to obtain maximum use from this facility."

The State Water Project, from which the West Side will obtain basic and supplemental water supplies, is discussed in the next section.

Water Development Projects

The Need for Water Management

A rapidly increasing population, a prosperous agricultural economy, and ever-expanding industries emphasize the magnitude of California's water problem and the importance of wise water management.

California appears to have an adequate gross supply of water to meet foreseeable requirements. An average of 30 million acre-feet, or 42 percent of the State's mean annual runoff, still wastes to the ocean from uncontrolled streams along California's north coast. On the other hand, 80 percent of the people in California live in metropolitan areas from Sacramento to the Mexican border; however, 70 percent of the State's water supply originates north of the latitude of San Francisco Bay [California Department of Water Resources, 1967b].

Thus, the historical solution to California's water problem has been one of conserving the sporadic stream runoff in surface storage reservoirs and transporting the regulated supplies to areas of use. Such imported supplies supplement pumpage from underlying ground water basins. Larger storage works and longer conveyance systems have been required to meet the continuing demands for water.

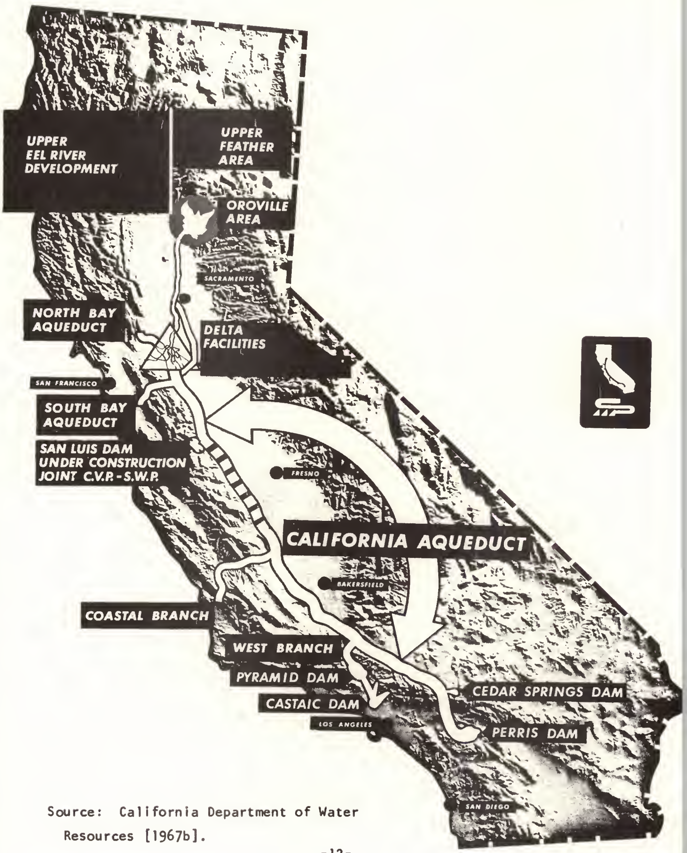
The State Water Project

The State Water Project, as the first unit of the California Water Plan, a \$2 billion undertaking of the State of California, will conserve waters now wasting to the ocean in the northern part of the State and deliver these waters through an extensive aqueduct system to the water-deficient San Joaquin Valley area and Southern California.

In addition to supplying water, the Project will provide flood, salinity, and drainage control, power, and recreational opportunities. The Project is fully coordinated with other water developments constructed by the Federal Government and local agencies. The United States Bureau of Reclamation is jointly constructing facilities with the State Water Project, as illustrated by the joint Federal-State San Luis Project and other features [California Department of Water Resources, 1967c].

Principal features of the State water facilities are a dam and reservoir at Oroville on the Feather River, from which releases will be made down the Feather River to the Sacramento River and thence into the Delta; a large canal along the West Side of the San Joaquin Valley from the Delta to the southerly reaches of the Valley, south of the City of Bakersfield; the San Luis Reservoir, a large regulatory storage facility near Los Banos which will be under joint ownership with the United States Bureau of Reclamation, as will a portion of the West Side Aqueduct; a large pumping plant to lift water over the Tehachapi Mountains into aqueducts serving the south coastal and high desert areas; and a coastal aqueduct extending into San Luis Obispo and Santa Barbara Counties. The principal dam sites and canal routes of this Project are shown in Figure 1.

Figure 1. Main Facilities of the California State Water Project



Source: California Department of Water Resources [1967b].

The Project will develop 4,230,000 acre-feet of firm water per year and will produce power at generating plants on the Feather River. The State holds applications to appropriate water for project purposes from Feather River and Delta. Water supplies from the Project have been contracted for by water districts and other political entities throughout the Project service area.

The contracts between the State and the various agencies are basically similar and require that each contractor assume a pro rata share of the financial obligation which the State incurs in constructing the California Aqueduct and related works from the Delta to the point of delivery to the contractor. Allocated costs are repaid by the contractor over a 50-year period with interest, the interest rate being equal to that paid by the State on its bonds. Each contractor must also pay its pro rata share of fixed operation and maintenance expenses on the aqueduct system and Delta water charge.

In addition, at the time that the water is actually taken, an additional charge for transporting the water to the point of delivery, termed the variable operation and maintenance charge, is also paid. This charge is largely the cost of power for pumping.

Since the schedule of entitlements for all contracts increases from a relatively small amount in the early years of Project operation to a maximum in year 1991, during this build-up period there will be "surplus" water which, in any year, is the then unused entitlement of all the contractors. The magnitude of this regulated surplus water in any year is dependent on the total amount of contract entitlement used in that year and the capacity of the system, including pumping plants, available to convey it.

During the early years of State Project operation and into the 1980's, it is probable that substantial amounts of surplus water will be available. However, as time goes on and the State water contractors approach their maximum annual entitlements, there will be less and less surplus water available on a regulated basis. Finally, surplus water will be of a nonregulated nature and available only in years of above average runoff and during portions of those years when aqueduct capacity is not being used to convey contract entitlements of firm water.

The State contracts provide for sale of this surplus water for agriculture and ground water replenishment at the cost of delivering it (variable cost).

All initial facilities of the State Water Project will not be completed until 1972; however, deliveries to the Kern County Water Agency at the proposed turnout of the Button Willow Improvement District started in the Spring of 1968.

Agricultural Service Areas

The total agricultural acreage that will benefit by the joint Federal-State water development (San Luis Forebay, etc.) and the State Water Development Program is approximately 1,496,300, of which 1,046,300 acres (mostly in Stanislaus, Kings, and Kern Counties), are independent of federally augmented water sources; 57.7 percent or 604,200 acres of this land represent land new in agriculture [Kirkpatrick, 1966].

The Westlands and Westplains Water Districts to be served by the San Luis Project combined, total 585,000 acres, most of which (450,000 acres) are in Fresno County [Fresno County Agricultural Extension Service, 1965]. These two water districts are merely contracting for surplus water from the California Aqueduct to augment their federal water. Presently about 30 percent of the irrigable land on the Western Fresno County lies fallow each summer for lack of water. With supplemental water, most of this acreage will produce crops each year.

Since the approval of the California Water Resources Development Bond Act in 1960, eight water agencies in the San Joaquin Valley have contracted with the State for annual water deliveries totaling a maximum of 1,355,000 acre-feet. The largest of these agencies in terms of water demand is the Kern County Water Agency, with an entitlement of 1,153,400 acre-feet. These quantities represent maximum contracted supplies and will not be received in this magnitude until 1990. Initial delivery to the Kern County Water Agency is scheduled for 1968, with total entitlement of 466,000 acre-feet. The total San Joaquin Valley Entitlement for 1968 is 96,900 acre-feet [Dean's Committee, 1968].

Implications of Water Development on Agriculture

Dimensions of the Problem

The development of the San Joaquin Valley West Side Project is expected to substantially affect the economy of the region and the State. The productive use of a dependable and large amount of imported irrigation water in the West Side will obviously cause that extensive and largely undeveloped area to be quite different from what it would be without this water.

On the other hand, new problems will arise because of water and land development. The economic problems associated with water and land development on the West Side of the San Joaquin Valley can be viewed in five major categories: production, demand, marketing, resource use and availability, and interregional and intra-California competition. This distinction of problem areas is somewhat artificial because they are interrelated. Nevertheless, it helps to discuss and clarify problems included in a systematic way.

Production Problems

Production problems associated with the land and water development on the West Side of the San Joaquin Valley can be considered at two levels; problems encountered by individual farms and those related to aggregate resource availability and use. Problems related to the possible cropping patterns in the West Side is discussed here, and aggregate resource use is discussed in a subsequent section.

Much of the previous work on cropping patterns has been based on payment capacity or "ability" of particular crops to pay for water. In other words, the total estimated cost--excluding the cost of water--of producing a particular crop has been subtracted from estimated total revenue (based on certain yield and price assumptions). The remainder is then the capacity of that particular crop to pay the cost of water [Dean's Committee, 1968].

The water is and will be relatively more expensive on the West Side (especially in the southern parts) than some other areas in

California. According to the original feasibility studies of the Department of Water Resources, it is almost imperative for farmers to produce high value specialty crops to offset the relatively high cost of water in almost all portions of the West Side (see, for example, California Department of Water Resources, [1962]). Payment capacities of almost all adaptable crops have been estimated and among all the crops considered only subtropical fruit (oranges), deciduous tree fruits (peaches, plums, nectarines, apricots, etc.), tree nuts (almonds and walnuts), grapes, some vegetable and truck crops (melons, potatoes, etc.), cotton, and sugar beets have the capacity to pay the high cost of water.

The necessity of producing high value crops, in order to pay the high cost of water and have some return, is supported by a study by Moore and Hedges [1963] on farm production on the East Side of the San Joaquin Valley which has somewhat lower water costs than the West Side. In that study, the authors considered three alternative cropping systems and various sizes of farm enterprises. The results of the study indicate that water should be channeled to lower return crops only after high value crops, such as cotton, have consumed the maximum acreage available and have received the full amount of water required. As water is put on the lower value crops, net returns per added foot of water decrease rapidly.

Perhaps the most important result of the irrigation aspects of the San Joaquin Valley West Side development will be an increased volume of agricultural production. The possible price reaction to the increased supplies of agricultural products is discussed in the next section.

Demand for Products

The ultimate market for most of the specialized crops of California lies outside of California, particularly in the urban areas of the East and the Midwest. The question may well be raised, how much will the agricultural development of the San Joaquin Valley West Side disturb the markets for the established agricultural producers of the San Joaquin Valley and other competing areas in the State? It seems likely that the extent of the disturbance will depend largely on the rate of irrigation and new land development and also on the manner in which it is coordinated with the need for additional irrigation.

A recent study by Farrell [1969] has estimated that in order for California to maintain its relative market status, it will have to increase its crop land by 1980 by some 750,000 acres, with more acreage being devoted to fruit crops, feed grains, vegetables, sugar beets, cotton, and alfalfa.

On the other hand, it is argued that:

> " . . . since the development of the West Side will be a gradual event, spread over a 22-year period, and since population is expected to increase, it seems likely that effects in prices from increased production will be minimized unless an imbalance develops in particular crops. Thus, for example, specialization of West Side production in oranges or almonds could be disastrous to producers everywhere if the market were to be glutted by surplus production, but as long as cropping is diversified, such should not be the case . . . " [Dean's Committee, 1968, p. 49].

Production of Marketing Services

Readily available marketing facilities are a necessary requirement if an area is to become a large-scale producer of agricultural products. The relation between the agricultural production and agricultural processing industries in an area is two-fold. The types of agricultural production which are physically and economically feasible set a certain limit to handling and processing but the efficiency with which these functions are carried on may go far toward determining the economic feasibility and scale of production of a particular commodity. Transportation, processing, storage, and other marketing facilities for handling farm products have great importance in the agricultural development of an area.

The San Joaquin Valley West Side is physically adapted to a rather wide range of products, but economic considerations will strongly affect the relative volume of these commodities. One of the many economic considerations is the availability of favorable market outlets and, in many cases, a market outlet for the production of West Side farms will require that processing and marketing facilities be established in the area. The proximity of the Los Angeles and the San Francisco Bay area central markets coupled with the availability of good railroad and highway connections places the San Joaquin Valley West Side in a favorable position under present circumstances. On the other hand, at present the marketing facilities and a very few processing plants in the Project area are geared to an economy of field crops (cotton and barley) and a few specialty truck crops (melons and potatoes).

> "Potatoes are a well-established and commonly grown specialty crop in Kern County. Well located and efficient potato packing sheds are readily available; larger operators own and operate their own facilities, while the smaller ones contract with shed operators for the packing services necessary in potato marketing. Comparable facilities are available for cantaloupes on the West Side" [Hedges and Moore, 1965, p. 32].

Specialty crops quite commonly require special marketing arrangements, such as contracts, in addition to special facilities. Growers of potatoes and cantaloupes in various portions of West Side have a distinct advantage over other parts of the San Joaquin Valley because market outlets and packing facilities are already established and regularly handle substantial volumes of these products each year. Marketing outlets and facilities for cotton, alfalfa hay, blackeye beans, and the feed grains are available throughout the West Side.

Except for the marketing facilities noted above, marketing and processing facilities for the irrigated lands of the Project will have to be established. Nearby packing and processing facilities are especially necessary for the large-scale production of some fruits and vegetables. If processing facilities are currently not available on the West Side area, commodities may be shipped to existing processing locations.

Resource Use and Availability

The problems in resource use and availability involve land, water, labor, capital, and management resources. The degree or seriousness of problems created by the introduction of full-scale irrigation to an area depends partly on whether the particular irrigation project is concerned with the reclamation of wasteland or whether it is proposed for an area which is currently supporting profitable agricultural operations. Both situations can be found on the West Side of the San Joaquin Valley. Of the 1.5 million acres which will benefit from the West Side irrigation project, 900,000 acres are, at the present time, supporting dry land and/or limited irrigated agriculture. The remaining 600,000 acres is brought into agriculture for the first time.

Successful agriculture on the new lands of the West Side depends on the land capable of growing crops high enough in value to repay the costs of production plus interest and profit on the invested capital.

The major problem in land use is the peculiar land ownership pattern prevailing in the West Side. West Side farmers operate considerable amounts of rented land. One reason for this is large holdings by Southern Pacific Railway Company, Standard Oil Company, and other corporations [Faris and Kadishay, 1959]. It is obvious that the economic and sociological implications of change are such as to produce extended controversy among those whose futures may be affected. The nature of land ownership may play an important role in the determination of cropping patterns for a particular farm and, therefore, for a region as a whole [Dean's Committee, 1968, p. 48].

Serious problems of adjustment, other than a mere shifting from the present extensive farming to irrigated intensive farming, would be created by such a shift. Change in land use will cause appropriate changes in the nature, as well as the size, of the farm unit. These changes will increase the number of farm opportunities and thus expand farm labor requirements.

As far as the individual farm operator and his management function is concerned, he must learn a new technique since irrigated farming differs in many ways from dry land farming. He will want to know the best way to change from dry land to irrigation farming, how much development for irrigation will cost, and what labor and equipment will be required for irrigation. He must recognize the need for learning new managerial skills, especially during initial phases of establishing irrigation. Additional investment required for irrigation points up the need for increased credit or capital. The economic feasibility of various crops is of obvious importance to lending agencies as well as producers in the State.

Economic Feasibility of Production

The problem of determining the economic feasibility of production in a given region has many dimensions. Consideration must be given to the demand for the commodities, the location of processing facilities, and the transportation costs to markets; production aspects include the alternative crops that can be produced in that region as well as the costs of production for all commodities; further, consideration must be given to the competition from other regions in meeting demand in the markets; questions of resource availability in a dynamic framework include projected demands of urban land use, water use, mechanization and labor demand, and the availability of capital for development projects. This type of framework for certain field crops has recently been completed by Shumway, *et al.*, [1970], but orchard crops were not analyzed.

Although it is fairly easy to specify dimensions of a problem such as this, it is very difficult to quantify estimates. We have adopted a very simplified approach in analyzing the deciduous tree fruits and, thus, are open to criticism from various directions. First, it considers only one sector, and ignores important considerations of demand interrelationships. Second, it places emphasis on the demand side and does not include estimates of supply response except as a set of alternative possible levels of production. Third, it does not consider the complexity of institutional restraints that may affect the economic outcomes. We justify this approach only in that it appears to offer insights that may be of value to this sector of the agricultural industry. It certainly must be used in conjunction with other studies, rather than _the_ answer to a most complex problem of production adjustment. Our emphasis is on the demand for these fruits projected to 1980. Consideration is then given to the bearing acreage associated with 1980 yields and alternative levels of production and price.

Summary

This section provides a review of the problems involved in and the implications of water development on the San Joaquin Valley West Side agriculture. Currently inadequate irrigation water supplies represent the dominant problem in producing high value crops in this area. The California Aqueduct will increase the water supply of the area and will probably be a dominant factor in structuring a reorientation and in giving increased emphasis to irrigated agriculture possibilities.

On the other hand, the water and associated land development may introduce the following problems to the West Side as well as to the State agriculture: (a) production problems associated with the aggregate effect of the West Side development on the State's agriculture due to the changes in State-wide production patterns, (b) demand problems associated with the increased production of some commodities and their price disturbing-effects on local and national markets, (c) marketing problems associated with the present availability and the future establishment of processing and marketing facilities in the West Side, and (d) resource use and availability problems associated with the shifts in agricultural resource use due to the gradual intensification and diversification of the West Side agriculture.

AN ECONOMIC MODEL OF DEMAND FOR DECIDUOUS TREE FRUITS

General Considerations

In this study, the five deciduous tree fruits--apricots, freestone peaches, cling peaches, nectarines, and plums--are treated as interrelated in demand and independent from all other commodities. This obviously is a simplification, but seemed necessary due to the large number of relationships involved in the model.

There are four essential characteristics of the economic model. First, production of fruit is assumed to be independent of current year prices and, thus, is specified as predetermined. No supply equations are considered. Second, farm production of apricots and freestone peaches are allocated to four markets; namely, fresh, canning, drying, and freezing. Canning is the only significant market for cling peaches and the fresh market is the major outlet for nectarines and plums. Third, the demand for processed fruit (canned, dried, and frozen) is specified, in general, for three markets; namely domestic, export, and stocks. Fourth, prices and quantities in various outlets are specified as jointly determined, with changes in one market interrelated with all other outlets. The farm and processor demand levels thus are determined simultaneously, with prices related by margin equations.

The model includes 50 variables determined within the system (endogenous variables) and 18 variables considered to be determined outside the system (exogenous variables). An outline of the model is given below, followed by a more complete discussion of the economic rationale for the equation specification. The behavioral equations include 11 for farm-level demand, 14 for processor-level demand for processed fruits, 11 for farm-processor price relations, and 11 for grower-allocation equations, for a total of 47 equations. An additional three identity equations are specified for market-clearing equations for canned apricots, cling peaches, and freestone peaches. The notation for the model is given in Table 2.

TABLE 2

Notation for Tree Fruit Model

Item	Variable classification a/	Apricots		Freestone peaches		Cling peaches		Nectarines		Plums		Other variables
		Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	
Raw fruit												
California production												
Fresh	Endog.	Q^{FA}_{W}	P^{FA}_{g}	Q^{FFP}_{W}	P^{FFP}_{g}	--	--	Q^{FN}_{W}	P^{FN}_{g}	Q^{FP}_{W}	P^{FP}_{g}	--
Canning	Endog.	Q^{CA}_{P}	P^{CA}_{g}	Q^{CFP}_{P}	P^{CFP}_{g}	Q^{CCP}_{P}	P^{CCP}_{g}	--	--	--	--	--
Drying	Endog.	Q^{DA}_{P}	P^{DA}_{g}	Q^{DFP}_{P}	P^{DFP}_{g}	--	--	--	--	--	--	--
Freezing	Endog.	$Q^{Fr.\ A}_{P}$	$P^{Fr.\ A}_{g}$	$Q^{Fr.\ FP}_{P}$	$P^{Fr.\ FP}_{g}$	--	--	--	--	--	--	--
All other	b/	--	--	--	--	Q^{CP}_{R}	--	Q^{N}_{R}	--	Q^{O}_{R}	--	--
Total	Exog.	Q^{A}_{T}	--	Q^{FP}_{T}	--	Q^{CP}_{T}	--	Q^{N}_{T}	--	Q^{P}_{T}	--	--
Other U.S. production	Exog.	--	--	Q^{WR}_{FP}	--	--	--	--	--	--	--	--
Foreign production	Exog.	Q^{FA}_{T}	--	Q^{FP}_{T}	--	--	--	--	--	--	--	--
Eastern auction price												
Fresh	Endog.	--	P^{FA}_{W}	--	P^{FFP}_{W}	--	--	--	P^{FN}_{W}	--	P^{FP}_{W}	--
Canned fruit												
Domestic demand	Endog.	Q^{CA}_{D}	--	Q^{CFP}_{D}	--	Q^{CCP}_{D}	--	--	--	--	--	--
Export demand	Endog.	Q^{CA}_{X}	--	--	--	Q^{CCP}_{X}	--	--	--	--	--	--
Stock change	Endog.	S^{CA}_{Δ}	--	S^{CFP}_{Δ}	--	S^{CCP}_{Δ}	--	--	--	--	--	--
Total pack	Endog.	Q^{A}_{C}	$P^{CA}_{f.o.b.}$	Q^{FP}_{C}	$P^{CCP}_{f.o.b.}$	Q^{CP}_{C}	$P^{CFP}_{f.o.b.}$	--	--	--	--	--
Beginning stocks	Exog.	S^{CA}_{B}	--	S^{CFP}_{B}	--	S^{CCP}_{B}	--	--	--	--	--	--
Dried fruit												
Domestic demand	Endog.	Q^{DA}_{D}	$P^{DA}_{f.o.b.}$	Q^{DFP}_{D}	$P^{DFP}_{f.o.b.}$	--	--	--	--	--	--	--
Export demand	Endog.	Q^{DA}_{X}	--	Q^{DFP}_{X}	--	--	--	--	--	--	--	--
Frozen fruit												
Domestic demand	Endog.	$Q^{Fr.\ A}_{D}$	$P^{Fr.\ A}_{f.o.b.}$	$Q^{Fr.\ FP}_{D}$	$P^{Fr.\ FP}_{f.o.b.}$	--	--	--	--	--	--	--
Beginning stocks	Exog.	$S^{Fr.\ A}_{B}$	--	$S^{Fr.\ FP}_{B}$	--	--	--	--	--	--	--	--
Other variables												
Personal disposable income	Exog.	--	--	--	--	--	--	--	--	--	--	D
Time trend	Exog.	--	--	--	--	--	--	--	--	--	--	T
Transportation cost	Exog.	--	--	--	--	--	--	--	--	--	--	C_T
Processing cost	Exog.	--	--	--	--	--	--	--	--	--	--	C_P
Marketing margin	Exog.	--	--	--	--	--	--	--	--	--	--	M

a/ Endogenous (or determined within the system) and exogenous (or variables assumed predetermined).
b/ The residual quantities of cling peaches, nectarines and plums going into minor outlets are not estimated in the model.

Outline of Economic Model

Behavioral Relationships

I. Farm Level Demand--Raw Fruit (equations 1-11).

A. Fresh Market

(Quantity sold fresh of a specified fruit is related to farm price of four fresh fruits, the quantity of freestone peaches produced in areas outside California, consumer income, transportation costs, a time trend, and a random error term).

1. Apricots:

$$(Q_W^{FA}, P_g^{FA}, P_g^{FFP}, P_g^{FN}, P_g^{FP}, Q_{WR}^{FFP}, D, C_T, T, u_1)$$

2. Freestone peaches:

$$(Q_W^{FFP}, P_g^{FFP}, P_g^{FA}, P_g^{FN}, P_g^{FP}, Q_{WR}^{FFP}, D, C_T, T, u_2)$$

3. Nectarines:

$$(Q_W^{FN}, P_g^{FN}, P_g^{FA}, P_g^{FFP}, P_g^{FP}, Q_{WR}^{FFP}, D, C_T, T, u_3)$$

4. Plums:

$$(Q_W^{FP}, P_g^{FP}, P_g^{FA}, P_g^{FFP}, P_g^{FN}, Q_{WR}^{FFP}, D, C_T, T, u_4)$$

B. Canning Market.

(Quantity sold for canning of a specified fruit is related to farm prices of three canned fruits, processing costs, beginning stocks of specified fruit, consumer income, a time trend, and a random error term.)

5. Apricots:

$$(Q_P^{CA}, P_g^{CA}, P_g^{CCP}, P_g^{CFP}, C_P, S_B^{CA}, D, T, u_5)$$

6. Cling peaches:

$$(Q_P^{CFP},\ P_g^{CFP},\ P_g^{CA},\ P_g^{CCP},\ C_P,\ S_B^{CFP},\ D,\ T,\ u_6)$$

7. Freestone peaches:

$$(Q_P^{CFP},\ P_g^{CFP},\ P_g^{CA},\ P_g^{CCP},\ C_P,\ S_B^{CFP},\ D,\ T,\ u_7)$$

C. Drying Market

(Quantity dried of a specified fruit is related to farm prices of two dried fruits, processing costs, consumer income, a time trend, and a random error term.)

8. Apricots:

$$(Q_P^{DA},\ P_g^{DA},\ P_g^{DFP},\ C_P,\ D,\ T,\ u_8)$$

9. Freestone peaches:

$$(Q_P^{DFP},\ P_g^{DFP},\ P_g^{DA},\ C_P,\ D,\ T,\ u_9)$$

D. Freezing Market.

(Quantity sold for freezing of a specified fruit is related to farm prices of two frozen fruits, processing costs, beginning stocks of two frozen fruits, consumer income, a time trend, and a random error term.)

10. Apricots:

$$(Q_P^{Fr.\ A},\ P_g^{Fr.\ A},\ P_g^{Fr.\ FP},\ C_P,\ S_B^{Fr.\ A},\ S_S^{Fr.\ FP},\ D,\ T,\ u_{10})$$

11. Freestone peaches:

$$(Q_P^{Fr.\ FP},\ P_g^{Fr.\ FP},\ P_g^{Fr.\ A},\ C_P,\ S_B^{Fr.\ FP},\ S_B^{Fr.\ A},\ D,\ T,\ u_{11})$$

II. Processor Level Demand--Processed Fruit (equations 12-25).

A. Domestic Market.

(Quantity demanded of a specified fruit is related to wholesale prices of that fruit and competing fruits, consumer income, wholesale-retail margin, a time trend and a random error term.)

12. Canned apricots:

$$(Q_D^{CA}, P_{f.o.b.}^{CA}, P_{f.o.b.}^{CCP}, P_{f.o.b.}^{CFP}, D, M, T, u_{12})$$

13. Canned cling peaches:

$$(Q_D^{CCP}, P_{f.o.b.}^{CCP}, P_{f.o.b.}^{CA}, P_{f.o.b.}^{CFP}, D, M, T, u_{13})$$

14. Canned freestone peaches:

$$(Q_D^{CFP}, P_{f.o.b.}^{CFP}, P_{f.o.b.}^{CA}, P_{f.o.b.}^{CCP}, D, M, T, u_{14})$$

15. Dried apricots:

$$(Q_D^{DA}, P_{f.o.b.}^{DA}, P_{f.o.b.}^{DFP}, D, M, T, u_{15})$$

16. Dried freestone peaches:

$$(Q_D^{DFP}, P_{f.o.b.}^{DFP}, P_{f.o.b.}^{DA}, D, M, T, u_{16})$$

17. Frozen apricots:

$$(Q_D^{Fr.\ A}, P_{f.o.b.}^{Fr.\ A}, P_{f.o.b.}^{Fr.\ FP}, D, M, T, u_{17})$$

18. Frozen freestone peaches:

$$(Q_D^{Fr.\ FP}, P_{f.o.b.}^{Fr.\ FP}, P_{f.o.b.}^{Fr.\ A}, D, M, T, u_{18})$$

B. Export Market.

(Quantity exported of a specified fruit is related to price of that fruit, exports of competing fruit, foreign production of that fruit, a time trend, and a random error term.)

19. Canned apricots:

$$(Q_X^{CA},\ P_{f.o.b.}^{CA},\ Q_X^{CCP},\ Q_T^{FA},\ T,\ u_{19})$$

20. Canned cling peaches:

$$(Q_X^{CCP},\ P_{f.o.b.}^{CCP},\ Q_X^{CA},\ Q_T^{FP},\ T,\ u_{20})$$

21. Dried apricots:

$$(Q_X^{DA},\ P_{f.o.b.}^{DA},\ Q_X^{DFP},\ Q_T^{FA},\ T,\ u_{21})$$

22. Dried freestone peaches:

$$(Q_X^{DFP},\ P_{f.o.b.}^{DFP},\ Q_X^{DA},\ Q_T^{FP},\ T,\ u_{22})$$

C. Commercial stocks of canned fruits.

(Change in stocks is related to wholesale price of fruit, quantity packed, beginning stocks, a time trend, and a random error term.)

23. Canned apricots:

$$(S_\Delta^{CA},\ P_{f.o.b.}^{CA},\ Q_C^{A},\ S_B^{CA},\ T,\ u_{23})$$

24. Canned cling peaches:

$$S_\Delta^{CCP},\ P_{f.o.b.}^{CCP},\ Q_C^{CP},\ S_B^{CCP},\ T,\ u_{24})$$

25. Canned freestone peaches:

$$(S_\Delta^{CFP},\ P_{f.o.b.}^{CFP},\ Q_C^{FP},\ S_B^{CFP},\ T,\ u_{25})$$

III. Farm--Processor Price Relationships (equations 26-36).

(The grower price for a specified outlet is related to the processor f.o.b. price, a time trend, and a random error term.)

A. Processing Market.

26. Canning apricots:

$$(P_g^{CA}, P_{f.o.b.}^{CA}, T, u_{26})$$

27. Canning cling peaches:

$$(P_g^{CCP}, P_{f.o.b.}^{CCP}, T, u_{27})$$

28. Canning freestone peaches:

$$(P_g^{CFP}, P_{f.o.b.}^{CFP}, T, u_{28})$$

29. Drying apricots:

$$(P_g^{DA}, P_{f.o.b.}^{DA}, T, u_{29})$$

30. Drying freestone peaches:

$$(P_g^{DFP}, P_{f.o.b.}^{DFP}, T, u_{30})$$

31. Freezing apricots:

$$(P_g^{Fr.\ A}, P_{f.o.b.}^{Fr.\ A}, T, u_{31})$$

32. Freezing freestone peaches:

$$(P_g^{Fr.\ FP}, P_{f.o.b.}^{Fr.\ FP}, T, u_{32})$$

B. Fresh Market.

33. Fresh apricots.

$$(P_g^{FA}, P_w^{FA}, T, u_{33})$$

34. Fresh freestone peaches:

$(P_g^{FFP}, P_w^{FFP}, T, u_{34})$

35. Fresh nectarines:

$(P_g^{FN}, P_w^{FN}, T, u_{35})$

36. Fresh plums:

$(P_g^{FP}, P_w^{FP}, T, u_{36})$

IV. Grower Allocation Equations (equations 37-47).
(Quantity sold for a specified outlet is related to grower prices for that fruit in each outlet, the total quantity sold in all outlets, a time trend, and a random error term.)

A. Apricots:

37. Fresh:

$(Q_W^{FA}, P_g^{FA}, P_g^{CA}, P_g^{DA}, P_g^{Fr.\ A}, Q_T^{A}, T, u_{37})$

38. Canned:

$(Q_P^{CA}, P_g^{CA}, P_g^{FA}, P_g^{DA}, P_g^{Fr.\ A}, Q_T^{A}, T, u_{38})$

39. Dried:

$(Q_P^{DA}, P_g^{DA}, P_g^{CA}, P_g^{FA}, P_g^{Fr.\ A}, Q_T^{A}, T, u_{39})$

40. Frozen:

$(Q_P^{Fr.\ A}, P_g^{Fr.\ A}, P_g^{CA}, P_g^{DA}, P_g^{FA}, Q_T^{A}, T, u_{40})$

B. Cling peaches:

41. Canned:

$$(Q_P^{CCP},\ P_g^{CCP},\ Q_T^{CP},\ T,\ u_{41})$$

C. Freestone peaches.

42. Fresh:

$$(Q_W^{FFP},\ P_g^{FFP},\ P_g^{CFP},\ P_g^{DFP},\ P_g^{\text{Fr. FP}},\ Q_T^{FP},\ T,\ u_{42})$$

43. Canned:

$$(Q_W^{CFP},\ P_g^{CFP},\ P_g^{FFP},\ P_g^{DFP},\ P_g^{\text{Fr. FP}},\ Q_T^{FP},\ T,\ u_{43})$$

44. Dried:

$$(Q_P^{DFP},\ P_g^{DFP},\ P_g^{CFP},\ P_g^{FFP},\ P_g^{\text{Fr. FP}},\ Q_T^{FP},\ T,\ u_{44})$$

45. Frozen:

$$(Q_P^{\text{Fr. FP}},\ P_g^{\text{Fr. FP}},\ P_g^{CFP},\ P_g^{DFP},\ P_g^{FFP},\ Q_T^{FP},\ T,\ u_{45})$$

D. Nectarines:

46. Fresh:

$$(Q_W^{FN},\ P_g^{FN},\ Q_T^{N},\ T,\ u_{46})$$

E. Plums:

47. Fresh:

$$(Q_W^{FP},\ P_g^{FP},\ Q_T^{P},\ T,\ u_{47})$$

V. Market Clearing Relationships for Processed Products (equations 48-50).

(Quantity packed is equal to the quantity demanded domestically, quantity exported, plus stock change.)

48. Market clearing--canned apricots:

$$Q_C^A = Q_D^{CA} + Q_X^{CA} + S_\Delta^{CA}$$

49. Market clearing--canned cling peaches:

$$Q_C^{CP} = Q_D^{CCP} + Q_X^{CCP} + S_\Delta^{CCP}$$

50. Market clearing--canned freestone peaches:

$$Q_C^{FP} = Q_D^{CFP} + S_\Delta^{CFP}$$

Farm Level Demand--(Equations 1-11)

Fresh Market

Apricots, freestone peaches, nectarines, and plums are sold in the fresh market. No distinction is made between domestic sales and exports. This simplification is based on the reasoning that only apricots and freestone peaches are exported fresh, that fresh exports represent less than 10 percent of total fresh sales of these fruits, and that most sales are to Canada where demand conditions are similar to those in the United States.

The same variables are included in each of the four farm-level demand equations for fruit sold on the fresh market. The quantity sold fresh of each fruit is considered jointly determined with the price of that fruit and prices of competing fruits sold on the fresh market. Predetermined variables include United States production of freestone peaches outside California, consumer income, transportation costs, and a time trend. Actual quantities, rather than per capita values, are specified in this model.

Whereas California is the major producer of apricots, cling peaches, nectarines, and plums, about 70 to 75 percent of total United States production of freestone peaches is grown outside the State. Much of this production is sold fresh. The quantity of freestone peaches produced in other states is included as an exogenous variable. This specification is a simplification of the regional demand for tree fruits, as is the use of the crop-year period rather than interseasonal demand. Practical considerations prohibit the inclusion of such desirable aspects in this model.

Logarithmic values of personal disposable income are included to reflect population increase as well as income effects as such. The logarithmic specification allows an expected curvilinear relationship between quantity and income, holding prices constant. In addition, a time trend is included to account for changes in tastes not associated with income as such. Due to the correlation between time and the log of income variable, the net effect of each cannot be obtained, a problem generally faced in the use of time-series data. Estimates of income elasticities from cross-section data were not available for all fruits and, thus, were not used in this study.

Another variable expected to shift the demand for fresh use at the farm level is the marketing margin between farm or first delivery point and the wholesale or auction markets. The index of railroad freight rates for fruits and vegetables is used as a proxy variable for this marketing margin. This variable is included in each of the four fresh market demand equations.

Alternative Specification of Farm Level Demand--(Equations 1A-11A)

In the above set of equations, quantities are expressed as a function of prices. The statistical results of this model were satisfactory for the two-stage estimates discussed in the next section. However, much more reliable predicted values from the reduced form were obtained with an alternative specification of the farm-level demand sector. In this formulation prices were the normalized variable and quantities in each outlet were endogenous variables on the right hand side. An example for equation 1 and alternative equation 1A illustrate these differences:

> (Quantity of apricots sold fresh is related to the farm price of the four fresh fruits, the quantity of freestone peaches produced in areas outside California, consumer income, transportation costs, a time trend, and a random error time.)

Equation 1:

$$(Q_W^{FA}, P_g^{FA}, P_g^{FFP}, P_g^{FN}, P_g^{FP}, Q_{WR}^{FFP}, D, C, T, u_1)$$

> (The farm price of apricots is related to the quantity sold fresh of apricots, freestone peaches, nectarines, plums, the quantity of freestone peaches produced in areas outside California, consumer income, transportation costs, a time trend, and a random error term.)

Equation 1A:

$$(P_g^{FA}, Q_W^{FA}, Q_W^{FFP}, Q_W^{FN}, Q_W^{FP}, Q_{WR}^{FFP}, D, C, T, u_{1A})$$

Processing Market

Processing outlets include canning, drying, and freezing. Apricots and freestone peaches are sold in all three outlets, whereas most cling peaches are canned. The demand functions for canning are described in detail, and similar comments apply to the dried and freezing markets.

The quantity of a given fruit used for canning is jointly determined with prices of that fruit and competing fruits received by growers. For example, the quantity of freestone peaches sold for canning is related to the grower prices for canning freestone peaches, cling peaches, and apricots. Other variables in each equation are personal disposable income, time trend, cost of processing, and the beginning season canners' stocks of the particular fruit, which, in our example, would be canners' stocks of canned freestone peaches. No additional comment is required for inclusion of the income and trend variables. The processing cost variable is expected to be inversely correlated with quantity sold for canning, holding other variables constant. A satisfactory time series was not available for processing costs for the 1924-67 period. Since labor wages account for more than 50 percent of processing costs, an index of hourly wage rates of production workers in canning and preserving industries is used as a proxy variable for total processing costs.

The specification of the grower-level demand for frozen apricots and frozen freestone peaches is similar to that for canned fruits except that here beginning stocks of each fruit are included in each equation. The time series is for the postwar period only.

The grower-level demand equations for dried apricots and dried freestone peaches do not include a stock variable. This variable was omitted due to the lack of a reliable series, and, also, because stocks of dried fruit are not as important relatively as for canned fruit.

The grower allocation of a particular fruit, such as apricots, to the outlets of fresh, canned, dried, and frozen is discussed in relation to equations (37-47). Briefly, this supply allocation is related to prices in each outlet and the total production of apricots in that year. Thus, these allocation equations (37-47) plus the farm-level demand equations (1-11) provide a specification of interrelationships at the farm level.

Processor-Level Demand for Processed Fruit (Equations 12-25)

There are three markets for processed fruit specified in this model; namely, the domestic market (canned, dried, and frozen), the export market (canned and dried), and the demand for stocks (canned fruit only).

Domestic Market

The demand equations for canned fruits (apricots, cling and freestone peaches) include endogenous variables of quantities consumed domestically and f.o.b. prices for the three canned fruits. Prices of other fruit or fruit sold in other markets are not considered. Exogenous variables are personal disposable income, time trend, and a marketing margin index. This index was constructed from data on retail price indexes and wholesale price indexes for processed fruits. This proxy variable for marketing margins is included in all domestic demand equations and would be expected to be inversely related to quantity consumed, holding other variables constant.

Similar demand equations are specified for the domestic dried fruit markets (apricots and freestone peaches) and for frozen fruits (apricots and freestone peaches). Prices and quantities in each market are endogenous variables, and income, trend, and margin are exogenous variables.

Export Market

Because of the reasons cited earlier in the discussion of the fresh market, no distinction is made between fresh sales to domestic outlets and to export. Therefore, the export market does not contain any demand equations for fresh fruit exports. On the other hand, canned freestone peaches are not exported and frozen apricot and freestone peach exports are so small that, for practical purposes, these can be neglected completely. This elimination of fresh fruits and some processed products from the export market subsector requires formulation of only four export relations; namely, canned apricots and cling peaches and dried apricots and freestone peaches.

Conceptually, the demand by importing countries for United States canned and dried apricots and peaches are analogous to domestic demand except that availability of foreign exchange influences the ability of countries to purchase United States exports. Therefore, a complete export demand model would hypothesize a jointly determined relationship between export price, export sales, competing commodities (in this case, supplies of canned and dried apricots, peaches, and other fruits from other countries) and would include other variables such as foreign income and import tariff rates but empirically, the availability of data complicates estimation of parameters in such a model.

United States canned and dried fruits are imported by a large number of heterogeneous countries. It is difficult to measure availability of foreign exchange and income for a period of 37 years covered by this study or to obtain reliable data on quantities or prices of competing canned and dried fruits in foreign markets. In addition, it is difficult to obtain measures of actual import tariffs due to a variety of reasons.

In view of the problems associated with estimating such a model, a simplified export demand relation for each commodity is specified. In the relation, f.o.b. price and quantity exported are hypothesized to be jointly determined. As a measure of the influence of foreign production on United States export demand, two predetermined variables representing total foreign production of apricots and of peaches also are introduced. To account for changes in tastes and preferences, and to serve as a proxy variable for income, which reflects the increasing purchasing power and availability of foreign exchange in importing countries, a time trend variable is also introduced. Finally, export sales of canned apricots and cling peaches in canned export equations and dried apricots and freestone peaches in dried export equations are interchanged in order to account for the competition in export sales of substitutable commodities in the United States.

Commerical Stocks of Canned Fruits

Stock relations for dried and frozen fruits are not included in this section. Stocks and stock changes in dried fruits are not too large. Thus, for practical purposes, the quantities packed can be assumed to be equal to quantities shipped domestically plus exports. The changes in stocks of frozen fruits are not included to simplify the model.

In this model, the canner demand for carry-out stocks of canned apricots, cling and freestone peaches is formulated in terms of changes from the previous year's carry-out position. Thus, stock changes are positive or negative, depending on whether canned apricots, cling and freestone peaches displayed a net movement in or out of storage during the marketing year. Current f.o.b. canned fruit prices, price expectations, raw fruit production forecasts for the next year, and the level of other canned fruit stocks influence commercial requirements for carry-out stocks of canned apricots, cling and freestone peaches.

The change in the stocks of a particular canned fruit (say canned apricot stocks), is expressed jointly in a function with the f.o.b. price of canned apricots and three other variables, all of which are predetermined. The predetermined variables are the total annual pack of California canned apricots, opening stocks of canned apricots, and a time trend. The larger the carry-in stocks of canned apricots, the smaller would be the expected increase in canned apricot stocks. Conversely, the larger the total pack of canned apricots, the larger would be the expected increase in canned apricot stocks. Stock relations are formulated for canned cling and freestone peaches with similar reasoning for the inclusion of variables as for canned apricots.

Farm-Processor Price Relationships--(Equations 26-36)

The economic model of the California deciduous fruit industry in this study combines two levels of demand for deciduous fruits. First is the demand for deciduous fruits at the farm level for such outlets as fresh market, canning, drying, and freezing. This level of demand arises by the requirements of wholesalers, canners, and packers (driers and freezers), respectively. Second is the demand for fresh and processed (canned, dried, and frozen) fruits at the wholesale and the processor levels, respectively.

In order to provide a link of the demand structure at the farm level for raw fruits to the demand structure at the wholesale and processor levels for fresh and processed (canned, dried, and frozen) fruit, respectively, the model includes seven farm-processor f.o.b., and four farm-wholesale price equations.

In these price-linkage relations, the price obtained by growers in a particular outlet for each fruit is expressed jointly in a function with the wholesale or processor f.o.b. price of that outlet and a time-trend variable.

Grower Allocation Equations--(Equations 37-47)

In general, two phases can be distinguished in the supply of agricultural products to the market. In the first phase, the quantity to be produced is determined by the various producers. In the second phase, total production is given and new decisions are made as to the quantity to be sold in different outlets.

The production of deciduous fruits is influenced primarily by factors other than current price, such as factors affecting yields and long-run influences on bearing acreage. In this study, production is considered predetermined and emphasis is placed on the allocation of supply among alternative outlets such as fresh, canning, drying, and freezing. It should be noted that allocation among market outlets is influenced by quality and size considerations. However, these aspects are not included in this model.

The several allocation equations, one for each outlet of each fruit, are intended to represent the allocation process explained above. A functional relationship is hypothesized between the quantity allocated to and price obtained in a particular outlet, both being jointly determined. Further, prices obtained in other outlets are also included and treated as endogenous variables if a particular fruit has more than one major outlet. Two predetermined variables in each allocation equation are the total quantity of each fruit utilized in, or allocated to, all outlets and a time trend. It is the hypothesis that, in an allocation equation, the estimated coefficient of the total quantity sold variable will show the average proportion of this fruit being allocated to this particular outlet and the sum of these coefficients in all outlets will be equal to one for each fruit. Further discussion of the role of these equations is given in the following section.

Market-Clearing Relationships

With several alternative markets, a model generally requires market-clearing identity equations that specify the sum of quantities sold in the various markets be identically equal to the total available supply. In this model, consideration is given to the farm supply allocated to fresh, canning, drying, and freezing markets; to canned fruit allocated to the domestic market, exports, and stocks; and to the dried and frozen fruit market outlets. Market-clearing equations are required only for the canning markets for apricots, freestone peaches, and cling peaches due to certain characteristics of the model including simplifying assumptions that will be explained below.

Canned Fruit (Equations 48-50)

The canned pack of apricots, for example, is equal to domestic sales, export sales, and the change in canners' stocks from beginning to end of the crop year. This is by definition and is expressed as Equation (48) in the model. A similar three-market outlet equation is given as Equation (49) for canned cling peaches. Only two market outlets are specified for freestone peaches, domestic sales, and stock demand, as given in Equation (50). These three market-clearing equations plus the 47 behavioral relations provide an identified system with 50 equations and 50 endogenous variables.

Dried and Frozen Fruits

Lack of complete data on stocks of dried and frozen fruits prohibited the imposition of market-clearing equations for four outlets; namely, frozen and dried apricots and frozen and dried freestone peaches. Comparison of the variables for canned fruit versus dried fruit, as given in Table 2, clarifies the difference in specification. Ideally, the variables for dried and frozen fruits should be the same as for canned fruit. For example, the sales of dried apricots should equal domestic sales plus exports and stock change during the year.

The major problem with this specification is that predicted dried fruit sales are not restricted by total sales, as would be true with a market-clearing identity. However, it will be seen next that farm sales for drying and freezing, as well as for fresh and canning, are restricted not by market-clearing equations as such but by the grower-allocation equations (37-47).

Fresh Fruit

Total production of each fruit is identically equal to the sum of quantities sold in the several markets. For cling peaches, nectarines, and plums, only one market outlet was significant and a small residual quantity for each was recognized but no demand function specified as such. This incomplete specification raised only minor concern in the quantification of the relationships, however. The more interesting case is that for apricots and freestone peaches. As is evident from Appendix Table A-1, the total production of apricots, for example, is equal to sales for fresh, canning, drying, and freezing. The same situation holds for freestone peaches. However, no market-clearing equations are required since the grower allocation equations force total production to be allocated among the four outlets. The set of allocation equations for apricots (equations 37-40) expresses sales (fresh, canned, dried, or frozen) as a function of prices in the four outlets plus total production of apricots and a time trend. Powell [1969] has shown that if all equations contain the same variables, the sum of coefficients associated with total quantity will equal one and the coefficients for each other variable will add to zero, if the equations are estimated by least-squares. If two-stage least-squares procedures are used, the coefficients will approach those given above. Thus, these allocation equations, which have this desirable property, replace the use of market-clearing identity equations in the model. For cling peaches, nectarines and plums, however, this property will not hold since the residual quantity demanded of each fruit is not included in the model.

Summary

This model of the demand for five deciduous tree fruits applies only to season average prices and quantities. Demand interrelationships are specified for the fresh, canning, freezing, and dried fruit markets. Certain simplifying assumptions are introduced, but the model still contains 47 behavioral and 3 market-clearing equations. The use of income and time-trend variables in the demand equations is not entirely satisfactory from a theoretical viewpoint, but reasons for this specification appear reasonable. Margin variables also are not what might be desired, but provide the needed shift in the function due to increased marketing costs over time. The statistical approach and empirical results are presented in the following section.

ESTIMATES OF DEMAND RELATIONSHIPS

Statistical Aspects

The simultaneous equation system described in the previous section includes 47 behavioral relationships plus three identity equations. Statistical estimates of the parameters are obtained using the two-stage least-squares method (TSLS) which is a consistent and asymptotically unbiased method of parameter estimation. Each of the 47 equations is overidentified; that is, the number of predetermined variables excluded from any given equation is greater than the number of endogenous variables included in that equation less one.1/ The total number of exogenous variables in the system is 18. Consider Equation (1), for example. It contains four exogenous and five endogenous variables. Thus, the number of excluded exogenous variables (14) exceeds the number of included endogenous variables less one (4).

The sample period includes 37 marketing years covering the period from 1924 to 1966, excluding the war period of 1941 to 1946. Price data are not deflated and quantities are in total rather than per capita terms. A complete description of the variables and sources of data are provided in Appendix A.

The two-stage least squares estimates of the parameters are given in this section with a discussion of their validity based on *a priori* expectations of signs and on the statistical significance of parameters.

Certain test statistics also are reported, although not theoretically valid for two-stage least square estimates. The figure in parentheses beneath each regression coefficient is the standard

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1/ This order condition for identification is a necessary but not sufficient condition. The rank conditions involve true values of structural parameters, which are not known with certainty, as discussed by Christ [1966, p. 322]. For this model, only order conditions are considered for identification.

error. Although the traditional significance tests, designed mainly for the ordinary least squares estimates, are not appropriate for two-stage least squares estimates, an idea of the validity of each estimated coefficient and the reliability attached to its sign can be obtained by comparing the coefficient with its standard error.

Because in a simultaneous estimation procedure all endogenous variables are determined jointly, some econometricans argue that R^2 is of no value as an indicator of the usefulness of a structural relation [Christ, 1966]. In spite of these arguments, R^2 is reported for each of the estimated TSLS formulation as a measure of goodness of fit of the linear relationship between the normalized variable, the predicted included endogenous variables, and included exogenous variables.

The last columns of the following tables give the values of the Durbin-Watson statistic. It is used to test the hypothesis of non-autocorrelated disturbances. In only four cases out of 47 equations, values of "d" are unacceptable, i.e., the hypothesis of random disturbances is rejected.

Farm-Level Demand Estimates

Fresh Market

Equations (1-4) in Table 3 are the TSLS estimates of demand relations for fresh apricots, freestone peaches, nectarines, and plums. It was hypothesized that quantities utilized in fresh market of four fruits and their prices are jointly determined under the influence of income and other exogenous variables which change over time. With a few exceptions, the signs on the coefficients for the four fresh demand relations were in accord with the theoretical expectations and were mostly significant within 5 and 10 percent probability levels using a one-tail test. The price of each fresh fruit and the quantity demanded are negatively related, as would be expected. It was expected that the quantity demanded of each fruit and the prices of competing fruits are positively related. The signs on all competing fruit prices are not in agreement with this hypothesis. Similarly,

TABLE 3

Farm Level Demand for Fruit

Equation number	Normalized variable	Constant term	Grower price of fruit sold											Non-Calif. prod. of freestones Q_{WR}^{FFP}	Index of personal disposable income D	Cost of Transportation C_T	Cost of processing C_P	Beginning stocks					Time trend T	Statistic	
			Fresh use				Canning			Drying		Freezing						Canned			Frozen				
			P_g^{FA}	P_g^{FFP}	P_g^{FN}	P_g^{FP}	P_g^{CA}	P_g^{CCP}	P_g^{CFP}	P_g^{DA}	P_g^{DFP}	$P_g^{Fr.\ A}$	$P_g^{Fr.\ FP}$					S_B^{CA}	S_B^{CCP}	S_B^{CFP}	$S_B^{Fr.\ A}$	$S_B^{Fr.\ FP}$		R^2	d
1	Q_W^{FA}	43.78	-.1187 (.0430)	.2872 (.1796)	.0283 (.0673)	-.0329 (.0323)								.0005 (.0048)	- 14.47 (13.97)	- .1259 (.2430)							.2992 (.2199)	.52	.96
2	Q_W^{FFP}	114.65	-.0854 (.1325)	-1.6032 (.5533)	.8919 (.2073)	.0920 (.0994)								-.0422 (.0150)	102.13 (43.03)	-2.0279 (.7488)							- .1250 .6776	.90	1.59
3	Q_W^{FN}	-152.94	.0254 (.0477)	.7053 (.1992)	-.6368 (.0746)	-.0538 (.0358)								.0044 (.0054)	13.99 (15.49)	1.4006 (.2696)							1.5979 .2439	.97	2.00
4	Q_W^{FP}	- 45.95	.0137 (.0428)	- .3425 (.1789)	.2155 (.0670)	-.4481 (.0321)								-.0149 (.0048)	119.95 (13.91)	- .5330 (.2421)							- .6561 .2191	.96	2.33
5	Q_P^{CA}	- 45.18					-1.0064 (.2124)	- .8486 (.6535)	1.5034 (.6132)						50.72 (70.21)		88.12 (60.00)	-.0309 (.0073)					.1539 (.7308)	.89	1.45
6	Q_P^{CCP}	-596.71					-1.1952 (.5329)	-5.4148 (1.6467)	2.0686 (1.6063)						688.68 (190.40)		- 22.72 (161.27)		-.0377 (.0072)				3.2965 (1.9049)	.96	1.56
7	Q_P^{CFP}	- 53.59					.2394 (.1699)	.1953 (.4757)	- .6314 (.5533)						10.20 (68.05)		51.48 (49.42)			.0150 (.0087)			.9187 (.6109)	.94	1.79
8	Q_P^{DA}	422.86								-.6934 (.3410)	1.7821 (.9557)				-183.21 (135.22)		- 53.32 (97.36)						3.2894 (1.2189)	.78	2.64
9	Q_P^{DFP}	112.41								.3664 (.1956)	-1.6547 (.5481)				64.24 (77.55)		- 58.31 (55.84)						-2.0438 (.6991)	.89	3.17
10	$Q_P^{Fr.\ A}$	- 18.26										-.0425 (.0198)	-.0056 (.0527)		12.08 (7.19)		- 2.19 (6.17)				-.00034 (.00031)	.00013 (.00021)	.1124 .0612	.82	1.54
11	$Q_P^{Fr.\ FP}$	- 56.49										.0222 (.0634)	-.5616 (.1688)		18.21 (23.05)		30.68 (19.78)				.00055 (.00098)	-.00149 (.00069)	.6785 (.1962)	.90	.94

It was expected that the quantity demanded of each fruit would be positively related with income variable and negatively with cost of transportation. The first expectation was violated in the case of fresh and drying apricots and the second expectation in the case of nectarines. Possible explanations for these two cases are that only 5 to 6 percent of apricots are utilized in fresh form and, thus, the income effect can be of either sign, most of fresh nectarines are sold in the State, and an increase in cost of transportation causes further utilization in the State rather than out of the State.

Processing Market

The TSLS estimates of demand relations formulated for processing markets, namely canning apricots, cling and freestone peaches; drying apricots and the freestone peaches; and freezing apricots and freestone peaches are given in Table 3 as equations (5-11). As in the case of fresh fruit demand equations, most of the signs on estimated parameters are in accord with the theoretical expectations and statistically significant within 5 and 10 percent levels. The only coefficient of which either the sign is not in accord with the *a priori* expectations or not significantly different from zero is the coefficient of processing cost variable. A negative relationship was hypothesized between the quantity demanded for processing of each fruit and the processing costs. In the case of canning apricots and freestone peaches and freezing freestone peaches, the signs are positive and, in no case, is the coefficient statistically significant even at the 10 percent level. Coefficients of determination (R^2) range from 0.78 to 0.96.

Alternative Estimates of Farm-Level Demand

Estimates of parameters from the alternative specifications of farm level demand relationships are given in Table 4. These results compare favorably with those presented previously, and the range in R^2 values is .82 to .96 as compared with .52 to .96 for the original

TABLE 4

Alternative Formulation of Farm Level Demand for Fruit

Equation number	Normalized variable	Constant term	Quantities sold at farm level											Non-Calif. prod. of freestones Q_{WR}^{FFP}	Index of disposable personal income D	Cost of transportation C_T	Cost of processing C_P	Beginning stocks					Time trend T	Statistic	
			Fresh use				Canning			Drying		Freezing						Canned			Frozen				
			Q_W^{FA}	Q_W^{FFP}	Q_W^{FN}	Q_W^{FP}	Q_P^{CA}	Q_P^{CCP}	Q_P^{CFP}	Q_P^{OA}	Q_P^{OFP}	$Q_P^{Fr.\ A}$	$Q_P^{Fr.\ FP}$					S_B^{CA}	S_B^{CCP}	S_B^{CFP}	$S_B^{Fr.\ A}$	$S_B^{Fr.\ FP}$		R^2	d
1A	P_g^{FA}	-152.18	-1.6563 (1.4126)	-.2223 (.5087)	- .9376 (.5537)	- .0191 (.3833)								-.0444 (.0235)	169.70 (57.19)	.0591 (.9115)							.5841 (1.3616)	.86	1.96
2A	P_g^{FFP}	-154.55	1.2505 (.5440)	-.3310 (.1959)	- .6558 (.2132)	- .2053 (.1476)								-.0289 (.0091)	133.75 (22.02)	.0850 (.3510)							.0415 (.5244)	.91	2.03
3A	P_g^{FN}	-382.06	1.1511 (.9662)	-.1052 (.3480)	-1.8980 (.3787)	- .0877 (.2622)								-.0193 (.0161)	134.61 (39.12)	2.3699 (.6235)							1.9871 (.9313)	.96	2.11
4A	P_g^{FP}	-195.91	.3575 (.9952)	.5153 (.3584)	.0349 (.3901)	-2.0429 (.2701)								-.0120 (.0166)	219.37 (40.29)	.0873 (.6422)							-1.6090 (.9593)	.93	2.23
5A	P_g^{CA}	- 51.51					-.4785 (.1423)	-.0046 (.0460)	.0096 (.2494)						55.30 (75.79)		70.13 (49.62)	-.0214 (.0054)					- .4752 (.6680)	.82	2.00
6A	P_g^{CCP}	- 52.99					.1361 (.0790)	-.0754 (.0314)	-.2178 (.1532)						48.60 (47.72)		40.88 (31.58)		-.00439 (.00134)				.0722 (.4477)	.86	2.39
7A	P_g^{CFP}	- 91.97					.1733 (.0560)	-.0321 (.0208)	-.1660 (.1318)						75.85 (35.92)		1.037 (25.565)			-.0109 (.0041)			- .1547 (.2781)	.88	1.94
8A	P_g^{OA}	- 87.72								-.1345 (.1213)	.1455 (.2252)				51.05 (95.57)		65.98 (68.83)						.3929 (.9264)	.89	1.58
9A	P_g^{OFP}	- 39.66								.0401 (.0460)	-.1653 (.0854)				46.76 (36.25)		17.18 (26.11)						- .7718 (.3514)	.94	1.63
10A	$P_g^{Fr.\ A}$	- 89.47										-7.2290 (3.3898)	.5168 (.9141)		5.9771 (89.3648)		96.70 (61.05)				-.003825 (.003356)	.000293 (.001886)	1.3373 (.6937)	.96	2.52
11A	$P_g^{Fr.\ FP}$	- 27.33										1.6540 (1.2995)	-1.0543 (.3504)		- 27.81 (34.26)		88.45 (23.40)				.001672 (.001287)	-.003142 (.000723)	.8798 (.2659)	.96	1.43

formulation. Not all equations are "improved," as based on the R^2 criterion, and that for canned cling peaches is reduced from .96 to .86. As noted previously, the major reason for inclusion of this set is the marked improvement in predictive ability of the reduced form of the 50 equation models with equation set (1A-11A) rather than equation set (1-11).

Processor-Level Demand--Processed Fruit

Domestic Market

Equations (12-18) in Table 5 are the TSLS estimates of demand relations formulated for processed fruits; namely, canned apricots, cling and freestone peaches; dried apricots and freestone peaches; and frozen apricots and freestone peaches. It was hypothesized that the quantity demanded at the f.o.b. level of each processed fruit is a function of its f.o.b. price, f.o.b. prices of competing processed fruits (all of which are jointly determined), exogenous variables of income, marketing margin, and a time trend.

The quantity demanded of each processed fruit is expected to be negatively related to its own price, positively to the prices of competing processed fruits, income, and marketing margin. The sign of the time trend depends on whether the demand for this particular fruit increases or decreases through time. As can be seen in Table 5, the signs on all variables, except canned apricot price in Equation 13, marketing margin in Equation 14, income in Equation 15, and the price of frozen freestone peaches in Equation 17, are in agreement with these hypotheses. Almost all of the coefficients are statistically significant at the 5 and 10 percent probability levels. R^2 values range from 0.65 to 0.97.

Export Market

The TSLS estimates of export demand relations for canned and dried fruits, namely, for canned apricots and cling peaches and for dried apricots and freestone peaches, are presented in Table 6. The

TABLE 5

Domestic Demand for Processed Fruit at F.O.B. Level

Equation number	Normalized variable	Constant term	F.o.b. price of fruit sold							Index of personal disposable income O	Marketing margin M	Time trend T	Statistic	
			Canned			Dried		Frozen						
			$P^{CA}_{f.o.b.}$	$P^{CCP}_{f.o.b.}$	$P^{CFP}_{f.o.b.}$	$P^{OA}_{f.o.b.}$	$P^{OFP}_{f.o.b.}$	$P^{Fr.\ A}_{f.o.b.}$	$P^{Fr.\ FP}_{f.o.b.}$				R^2	d
12	Q_D^{CA}	- 4,343.96	-1,337.80	.2756	603.36					5,741.10	6.2461	- 43.14	.92	2.15
			(208.18)	(306.0)	(221.41)					(1,430.92)	(6.3586)	(30.75)		
13	Q_D^{CCP}	-35,369.40	-. 427.86	-5,855.64)	3.098.33					31,100.2	61.9707	- 297.05	.97	2.62
			(527.99)	(776.10)	(561.55)					(3,629.2)	(16.1270)	(77.99)		
14	Q_D^{CFP}	- 446.42	234.42	1,193.22	-1,178.94					78.1500	- 7.5194	140.32	.95	1.74
			(247.66)	(364.04)	(263.40)					(1,702.3)	(7.5647)	(36.58)		
15	Q_D^{OA}	37.23				-.4614	.6588			- 15.5110	- .0046	.2891	.65	2.71
						(.1436)	(.3326)			(9.7843)	(.0503)	(.1719)		
16	Q_D^{OFP}	8.65				.1148	-1.0069			4.1729	.0837	.0922	.87	2.40
						(.1209)	(.2799)			(8.2352)	(.0423)	(.1447)		
17	$Q_D^{Fr.\ A}$	-31,332.10						- 551.45	- 113.38	15,128.5	44.6282	304.91	.85	1.07
								(558.38)	(503.52)	(5,853.7)	(26.5557)	(100.08)		
18	$Q_D^{Fr.\ FP}$	-95,635.30						203.13	-1,743.36	35,653.9	249.1960	1,248.81	.95	1.25
								(1,147.49)	(1,034.75)	(12,029.6)	(54.5728)	(205.68)		

TABLE 6

Export Demand for Canned and Dried Fruit

Equation number	Normalized variable	Constant term	F.O.B. price of fruit sold				Quantities exported				Total foreign production		Time trend T	Statistic	
			Canned		Dried		Canned		Dried						
			$P^{CA}_{f.o.b.}$	$P^{CCP}_{f.o.b.}$	$P^{DA}_{f.o.b.}$	$P^{DFP}_{f.o.b.}$	Q^{CA}_X	Q^{CCP}_X	Q^{DA}_X	Q^{DFP}_X	Q^{FA}_T	Q^{FP}_T		R^2	d
19	Q^{CA}_X	723.04	-21.93 (32.38)					.0595 (.0228)			-.2530 (.4025)		-12.98 (4.31)	.70	2.12
20	Q^{CCP}_X	-1,548.78		-449.23 (130.17)			2.7332 (1.0778)					1.5429 (.1865)	88.18 (18.19)	.86	1.41
21	Q^{DA}_X	.2090			-.1012 (.0481)					3.0420 (.3825)	.0022 (.0005)		.0586 (.0715)	.91	2.77
22	Q^{DFP}_X	1.5233				-.0345 (.0472)			.2073 (.0425)			.0002 (.0003)	- .0005 (.0275)	.81	2.30

quantity exported of a competing canned or dried fruit, and its f.o.b. processor price, quantity exported of a competing canned or dried fruit, exogenous variables of total foreign production of this fruit, and a time trend. A measure of foreign income could not be included in these export demand equations for reasons cited earlier. The f.o.b. processor prices and the quantities exported in all four equations are negatively related, as would be expected. On the other hand, positive signs obtained on quantities exported of other canned and dried fruits are somewhat difficult to interpret. One would expect that canned apricots and cling peaches would be competitive instead of complementary in a limited export market. The same is true for dried apricots and freestone peaches. A negative relationship is expected between the quantities exported of canned and dried fruits and the total foreign production of apricots and freestone peaches but this is obtained only in the export demand equation for canned apricots. Others are all positively related, a relation which seems unreasonable but unexplainable. Positive time trends in export demand equations for dried apricots and freestone peaches are also questionable in the face of declining export markets for dried fruits. Even with these somewhat unexpected signs, the overall explanation of the variation in exports is considered satisfactory.

Stocks of Canned Fruit

Equations (23-25) in Table 7 are the TSLS estimates of stock change relations for canned fruits. The relation hypothesized is that the net change in stocks of a canned fruit is related to its f.o.b. price, total quantity canned, marketing year beginning stocks of the same fruit, and a time trend. It is expected that the change in stocks of a particular canned fruit will be negatively related to the f.o.b. price, beginning stocks, and positively related to total quantities canned. The signs on all variables are in accord with the expectations but the R^2 values are not as high as in the case of previous equations, indicating that changes in stocks are explained by some other factors in addition to those included in stock change relations.

TABLE 7

Stock Demand for Canned Fruit

Equation number	Normalized variable	Constant term	F.O.B. prices of canned fruit			Quantity canned			Beginning stocks			Time trend	Statistic	
			$P^{CA}_{f.o.b.}$	$P^{CCP}_{f.o.b.}$	$P^{CFP}_{f.o.b.}$	Q^{A}_{C}	Q^{CP}_{C}	Q^{FP}_{C}	S^{CA}_{B}	S^{CCP}_{B}	S^{CFP}_{B}	T	R^2	d
23	S^{CA}_{Δ}	- 324.56	-46.3598 (84.8431)			.3953 (.0730)			-.7547 (.1457)			-12.9382 (9.1635)	.79	2.38
24	S^{CCP}_{Δ}	2091.90		-441.30 (260.32)			.2153 (.0653)			-1.0412 (.1743)		-40.8434 (36.6177)	.68	1.95
25	S^{CFP}_{Δ}	408.71			-129.35 (55.10)			.3012 (.0790)			-.9079 (.1741)	2.7905 (9.2986)	.49	2.25

Farm-Processor Price Relation Estimates

Equations (26-36) in Table 8 are the TSLS estimates of grower-f.o.b. price relationships formulated for canned, dried, frozen, and fresh fruits. Grower prices in various outlets for all fruits and their corresponding f.o.b. prices are all positively related, as would be expected. All f.o.b. price coefficients are statistically significant at the 5 percent level. The signs of time trend variable are more difficult to interpret than f.o.b. price coefficients but positive time trends in grower-f.o.b. price relations for canned fruits and negative time trend for dried, frozen, and fresh fruits are in line with the relative price movements through time in these outlets. The R^2 values are relatively high, ranging between 0.83 and 0.97.

Grower Allocation Equations

Results of the TSLS estimates of grower allocation among alternative markets are shown in Table 9. Apricots and freestone peaches, each having four outlets (fresh, canning, drying, and freezing), provide interesting empirical examples of the restraints on the sum of column coefficients discussed by Powell [1969]. As expected, the sum of coefficients associated with each price are approximately zero whereas that for total quantity is approximately one. The coefficient associated with the total quantity of cling peaches, nectarines, and plums, respectively, differs from one since the other outlets, considered as residual quantities, are not included in the model for reasons discussed previously.

The expected signs of the price coefficients are (a) positive for own-outlet quantity, and (b) negative for other-outlet quantities. Of the 32 price coefficients for apricots and freestone peaches, 18 are of expected sign and 14 incorrect; 9 of these incorrectly signed coefficients are for frozen fruit prices. The frozen fruit prices and quantities apply only to the postwar period when these

TABLE 8

Grower and Market Level Price Relationships

Equation number	Normalized variable	Constant term	Processor or auction price variable		Time trend T	Statistic	
			Coefficient	Variable		R^2	d
26	P_g^{CA}	-47.88	23.4390 (2.8211)	$P_{f.o.b.}^{CA}$	.3655 (.2094)	.83	1.63
27	P_g^{CCP}	-21.49	14.1004 (1.6768	$P_{f.o.b.}^{CCP}$	.4243 (.1331)	.85	2.28
28	P_g^{CFP}	-11.26	8.7096 (1.1802)	$P_{f.o.b.}^{CFP}$	.1872 (.1245)	.84	1.41
29	P_g^{DA}	4.43	2.5549 (.3565)	$P_{f.o.b.}^{DA}$	.1275 (.5394)	.91	1.97
30	P_g^{DFP}	7.62	2.0364 (.2865)	$P_{f.o.b.}^{DFP}$	- .2283 (.2336)	.89	1.50
31	$P_g^{Fr.\ A}$	1.17	7.3176 (1.1340)	$P_{f.o.b.}^{Fr.\ A}$	- .2603 (.5877)	.91	2.31
32	$P_g^{Fr.\ FP}$	1.96	4.6645 (.4741)	$P_{f.o.b.}^{Fr.\ FP}$	- .2310 (.2317)	.95	1.64
33	P_g^{FA}	-20.10	52.7136 (7.3976)	P_W^{FA}	-1.6214 (.7186)	.88	2.08
34	P_g^{FFP}	- 7.03	41.5630 (4.6663)	P_W^{FFP}	- .9352 (.2998)	.90	1.89
35	P_g^{FN}	1.22	35.2281 (2.2486)	P_W^{FN}	- .1043 (.3108)	.97	1.67
36	P_g^{FP}	-21.31	49.1668 (3.6544)	P_W^{FP}	-1.3274 (.3752)	.94	2.22

TABLE 9

Grower Allocation Equations

Equation number	Normalized variable	Constant term	Grower price received for fruit by outlet											Quantity sold in all outlets Q_t^i	Time trend T	Statistic	
			Fresh				Canning			Drying		Freezing					
			P_g^{FA}	P_g^{FFP}	P_g^{FN}	P_g^{FP}	P_g^{CA}	P_g^{CCP}	P_g^{CFP}	P_g^{DA}	P_g^{DFP}	$P_g^{Fr.\ A}$	$P_g^{Fr.\ FP}$			R^2	d
37	Q_w^{FA}	22.58	.0245 (.0417)				- .1275 (.0822)			-.1123 (.0450)		.1325 (.0563)		.0157 (.0165)	.0173 (.0154)	.52	.61
38	Q_p^{CA}	-116.67	.1322 (.1869)				1.0830 (.3683)			.0322 (.2015)		-.5584 (.2521)		.4249 (.0739)	2.4284 (.6889)	.88	2.02
39	Q_p^{DA}	100.92	-.2038 (.1863)				- .9902 (.3671)			.1137 (.2009)		.5206 (.2513)		.5457 (.0737)	-2.8240 (.6867)	.94	1.93
40	$Q_p^{Fr.\ A}$	- 9.87	.0142 (.0154)				.0761 (.0304)			.0108 (.0166)		-.0880 (.0208)		.0138 (.0061)	.2770 (.0569)	.83	1.50
	Total		-.0329				.0414			.0444		.0067		1.0001	- .1013		
41	Q_p^{CCP}	- 59.32						.9211 (.1871)						1.0237 (.0373)	- .5328 (.5012)	.99	.99
42	Q_w^{FFP}	30.28		.4018 (.4647)					-.2944 (.4133)		- .9097 (.3169)		.8464 (.4099)	.1896 (.0917)	.6820 (.3898)	.89	1.71
43	Q_p^{CCP}	- 89.26		-.4937 (.5576)					.4955 (.4959)		1.3319 (.3803)		-.2828 (.4918)	.2962 (.1101)	1.5152 (.4678)	.93	1.33
44	Q_p^{DFP}	92.99		.0221 (.5516)					-.2670 (.4906)		- .8010 (.3762)		-.2001 (.4866)	.4303 (.1089)	-2.7885 (.4627)	.93	2.18
45	$Q_p^{Fr.\ FP}$	- 32.95		-.0167 (.1819)					.0655 (.1618)		.4722 (.1241)		-.3574 (.1605)	.0776 (.0359)	.6319 (.1526)	.90	1.59
	Total			-.0865					-.0004		.0934		.0061	.9937	.0406		
46	Q_w^{FN}	.0199			-.0020 (.0020)									.9849 (.0060)	- .0062 (.0158)	.99	1.78
47	Q_w^{FP}	2.0440				-.0102 (.0067)								.9377 (.0185)	.0242 (.0368)	.99	1.00

commodities were introduced. Further study of all frozen fruits, including these two, would be desirable. For the total quantity variable all signs are positive as would be expected. Time trend coefficients can be either positive or negative depending on the shift in demand for particular commodities. The coefficients were negative and statistically significant for dried apricots and dried freestone peaches.

Demand Elasticities

Results of linear demand estimates are usually converted to elasticities. Price (direct and cross) and income elasticities, derived from the estimated demand relations (both for raw and processed fruits), are presented in Table 10.

Elasticity coefficients may vary over time. They also vary depending on the point on a linear demand schedule where they are measured. For purposes of this study, price and income elasticities of demand were computed from the estimated structural slope coefficients and data averages for the 1961-65 period.

Summary

If the results were evaluated according to their agreement with the economic theory and *a priori* expectations, the model would be considered to have performed quite satisfactorily. With a few exceptions, the signs on all coefficients conformed to *a priori* expectations; they were mostly significant at the 5 percent level; R^2 values, whether they prove much in a simultaneous system, were quite high; and, finally, there were no serious autocorrelation problems. Price and income elasticities computed from the estimated price and income slopes were also reasonable in sign and magnitude.

On the other hand, some questions concerning the basic structure of the model can be raised. The model, with the exception of four stock change equations, is strictly a static short-run (marketing year)

TABLE 1D

Price[a] and Income[b] Elasticities of Demand for Raw (farm level) and Processed (f.o.b. level) Deciduous Tree Fruits

Quantities	PRICES																		
	FARM LEVEL											F.O.B. LEVEL							
	Fresh Use				Canning			Drying		Freezing		Canned Fruits			Dried Fruits		Frozen Fruits		Income
	P_g^{FA}	P_g^{FFP}	P_g^{FN}	P_g^{FP}	P_g^{CA}	P_g^{CCP}	P_g^{CFP}	P_g^{DA}	P_g^{DFP}	$P_g^{Fr.\ A}$	$P_g^{Fr.\ FP}$	$P_{f.o.b.}^{CA}$	$P_{f.o.b.}^{CCP}$	$P_{f.o.b.}^{CFP}$	$P_{f.o.b.}^{DA}$	$P_{f.o.b.}^{DFP}$	$P_{f.o.b.}^{Fr.\ A}$	$P_{f.o.b.}^{Fr.\ FP}$	D
Q_W^{FA}	-1.345	1.559	0.232	-0.356															-0.530
Q_W^{FFP}	-0.100	-0.898	0.756	0.103															0.386
Q_W^{FN}	0.058	0.774	-1.057	-0.118															0.104
Q_W^{FP}	0.020	-0.241	0.230	-0.630															0.570
Q_P^{CA}					-0.707	-0.413	0.567												0.170
Q_P^{CCP}					-0.162	-0.507	0.150												0.444
Q_P^{CFP}					0.171	0.096	-0.241												0.035
Q_P^{DA}								-3.180	3.390										-2.234
Q_P^{DFP}								0.168	-3.134										0.784
$Q_P^{Fr.\ A}$										-0.559	-0.041								0.740
$Q_P^{Fr.\ FP}$										0.070	-0.982								0.246
Q_D^{CA}												-1.686	0.003	0.818					0.603
Q_D^{CCP}												-1.136	-1.389	0.888					0.690
Q_D^{CFP}												0.252	1.145	-1.366					0.007
Q_D^{DA}															-6.069	4.908			-0.143
Q_D^{DFP}															1.721	-8.551			0.438
$Q_D^{Fr.\ A}$																	-0.612	-0.122	0.512
$Q_D^{Fr.\ FP}$																	0.065	-0.542	0.347
Q_X^{CA}												-0.514							
Q_X^{CCP}													-0.397						
Q_X^{DA}															-3.740				
Q_X^{DFP}																-0.933			

[a] Calculated at average 1961-65 values.

[b] Calculated as follows:

$$\frac{\partial Q}{\partial Y} = b \frac{\partial \log_{10} Y}{\partial Y} = b \frac{1}{Y} \log_{10} e$$

$$\frac{\partial Q}{\partial Y} \cdot \frac{Y}{Q} = b \frac{1}{Y} \log_{10} e \cdot \frac{Y}{Q} = b \frac{\log_{10} e}{Q} = b \frac{(0.4343)}{Q}$$

model formulated under an assumed perfectly competitive market structure. In fact, the market structure is not perfectly competitive and there may be a dynamic adjustment process so that results in subsequent periods may depend on current and past market conditions.

Income elasticities were computed from the estimated income slopes in demand equations. If there were other effects such as the population effect and the effect of changes in tastes and preferences included in the income slope, the income elasticity computed from the latter would not reflect the pure income effect. In this respect, the inclusion of a time trend variable in all demand equations could not be justified on the ground that income and time are highly correlated. On the other hand, some variables were omitted due to the lack of data and the small degrees of freedom. Thus, a time trend variable was introduced as a "proxy" to account for the combined effect of these omitted variables.

It is clear that above limitations impose some restrictions on interpretation and application of estimates obtained in this analysis. However, they are still useful for various problems. The major price-affecting factors and their relative significance can be determined from the structural estimates. Magnitudes of price and income elasticities are useful measures of explaining the past trends in quantities sold in the face of increasing or decreasing prices and income. The elasticity concept as a guide to allocation and inventory policies in order to maximize industry revenues is a valuable measure. In general, these estimates provide the industry and governmental and private marketing organizations with materials which can be used in the formulation of marketing policies and programs.

Results obtained in this study and the previous studies by others are not directly comparable. Foytik [1951] and Hoos and Kuznets [1960 and 1969] have their demand equations, for plums and selected canned fruits, respectively, in the price dependent form whereas, in this study, demand equations are in quantity-dependent form. In addition, the level of marketing is different in the case of plums and price and income elasticities are not given in the case of canned fruits.

Foytik [1951] obtained auction market price elasticities of -2.84, -1.25, and -3.00 for early, midseason, and late varieties of plums, respectively. The farm level price elasticity of -0.630 for all plums obtained in this study is, as expected, less elastic than at the auction level.

Harrington and Gislason [1956] obtained retail price elasticities of -1.19 for Elberta peaches, -0.95 for Hale peaches, and -0.76 for apricots. The fresh use farm level price elasticities obtained in this study are -0.898 for freestone peaches and -1.345 for apricots; elasticity coefficients for canning are correspondingly lower.

SAMPLE PERIOD ACTUAL AND ESTIMATED VALUES AND PREDICTIONS FOR THE 1967 AND 1968 CROP YEARS

One of the major objectives of this study is to obtain estimates of demand coefficients that may be of assistance in determining the probable level of demand in 1980. Before turning attention to this problem, we provide a comparison of actual and estimated values of the 50 endogenous variables during the sample period of 1924-40 and 1947-66. Also, predicted values are given for the 1967 and 1968 crop years to indicate the short-term predictive use of the model. Klein [1968, p. 4] refers to this latter type as *ex post* prediction since data that are already in existence are used to predict values of endogenous variables that also are known but which were not included in the sample period. The projections for 1980 will be discussed in the following section.

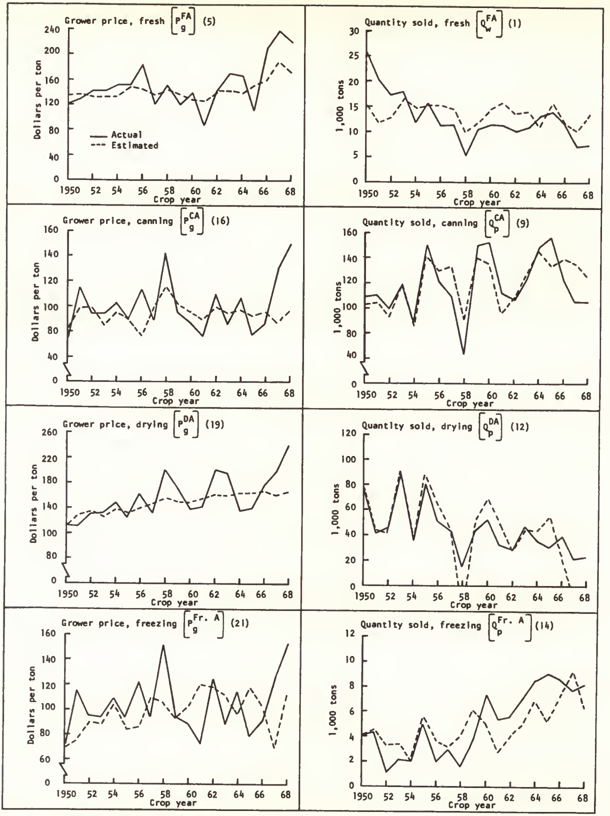
Actual and Estimated Values--1950-66

Estimated values of the endogenous variables are obtained from the reduced form of the structural equations (1A-11A) and 12 through 50. The equation set (1A-11A) was selected due to the improved predictive ability of this set over (1-11). The reduced form equations are given in Appendix Table B-1. It may be noted that these reduced form coefficients, the so-called "impact multipliers," preserve the market-clearing identities of equations (48-50), the characteristics of the grower-allocation equations (34-47), and the effect of the predetermined variables on the jointly determined endogenous variables.

Only values for the 1950-66 years of the sample period are plotted due to space limitations. These graphs will be discussed on the following pages. Estimates for previous years compare equally well with actual values.

Graphs of Estimated Values and Predictions for 1967 and 1968

Predictions of endogenous variables for 1967 and 1968 are also discussed in the following sections. The predicted values of these



Grower price, fresh $\left[P_g^{FA}\right]$ (5)

Quantity sold, fresh $\left[Q_w^{FA}\right]$ (1)

Grower price, canning $\left[P_g^{CA}\right]$ (16)

Quantity sold, canning $\left[Q_p^{CA}\right]$ (9)

Grower price, drying $\left[P_g^{DA}\right]$ (19)

Quantity sold, drying $\left[Q_p^{DA}\right]$ (12)

Grower price, freezing $\left[P_g^{Fr.\ A}\right]$ (21)

Quantity sold, freezing $\left[Q_p^{Fr.\ A}\right]$ (14)

Figure 2. Apricots: Season Average Farm Prices and Quantities Sold for Fresh Use, Canning, Drying, and Freezing, Actual and Estimated, 1950-68.

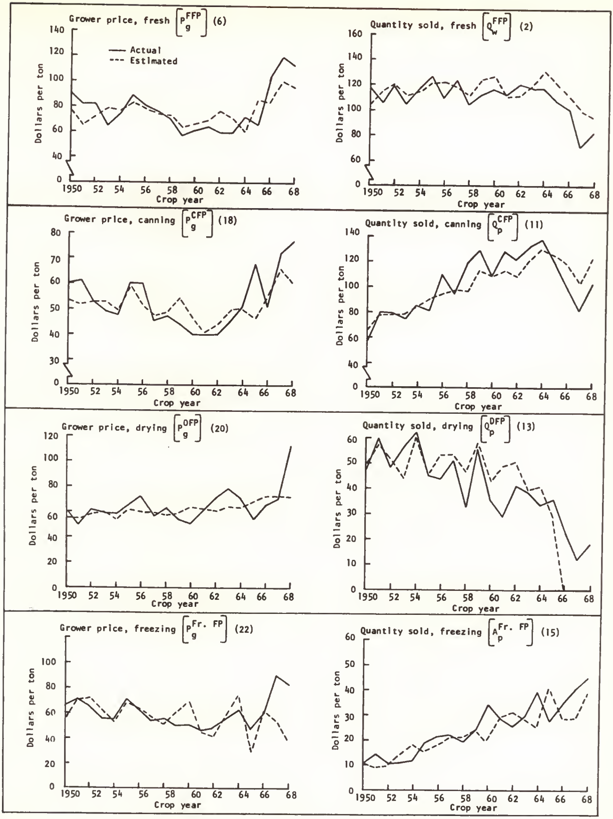


Figure 3. Freestone Peaches: Season Average Farm Prices and Quantities Sold for Fresh Use, Canning, Drying, and Freezing, Actual and Estimated, 1950-68.

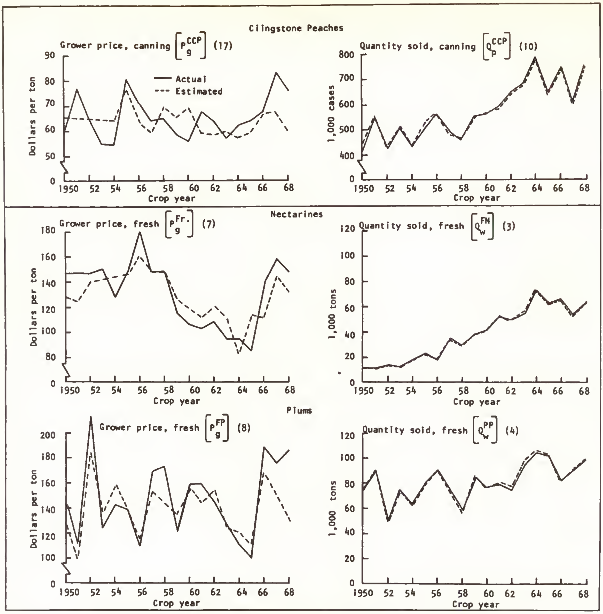


Figure 4. Clingstone Peaches, Nectarines and Plums: Season Average Farm Prices and Quantities Sold for Canning and Fresh Use, Actual and Estimated, 1950-68.

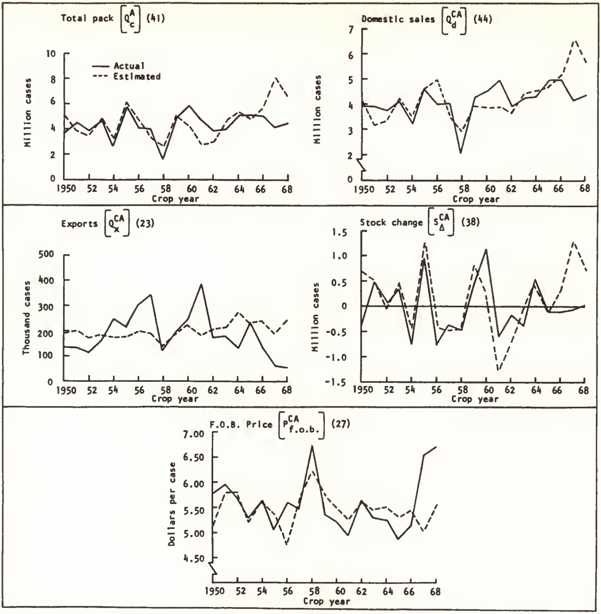
variables are not as accurate as we had desired. In fact, if the principal goal of the model were short-term forecasting, more work should be undertaken. Observations for 1967 and 1968 could be included in the sample period and the analysis rerun. However, it is instructive to see the types of problems in short-term predictions associated with a large model such as this.

Farm-Level Prices and Quantities Sold

There are 22 endogenous variables in the farm-level demand sector for raw fruit that are plotted in Figures 2, 3, and 4. It is noted that prices are underestimated for 1967 and 1968 crops for all market outlets and all fruits. One problem may be the inclusion of a time trend variable that may require continual updating of the coefficient as new data become available. Another problem is associated with apricots and freestone peaches sold for drying, in that predicted quantities are negative for 1967 and 1968 and also for apricots for 1958. Obviously, the model should be restricted to positive quantities, which is not a simple procedure in a model of this size. An alternative procedure is to adjust this estimate and obtain predicted prices from the structural equations. To elaborate on this point, the total sales of apricots must be allocated among the four outlets with the total quantity equal to total sales (see Appendix Table A-1). Actual and estimated values for 1968 are shown below:

Outlet	Apricots		Freestones	
	Actual	Predicted	Actual	Predicted
	(Thousand tons)		(Thousand tons)	
Fresh	7.5	13.6	83.0	94.8
Canning	105.6	125.3	103.0	120.6
Drying	23.1	- 1.8	18.3	- 4.2
Freezing	8.2	6.3	44.8	37.8
Total	144.4	143.4	249.9	249.0

It is clear that the model overstates the decline in the drying market and conversely allocates an oversupply to the fresh and canning



Total pack $\left[Q_c^A\right]$ (41)

Domestic sales $\left[Q_d^{CA}\right]$ (44)

Exports $\left[Q_x^{CA}\right]$ (23)

Stock change $\left[S_\Delta^{CA}\right]$ (38)

F.O.B. Price $\left[P_{f.o.b.}^{CA}\right]$ (27)

Figure 5. Canned Apricots: F.O.B. Price, Total Pack, Domestic Sales Exports, and Stock Change, Actual and Estimated, 1950-68.

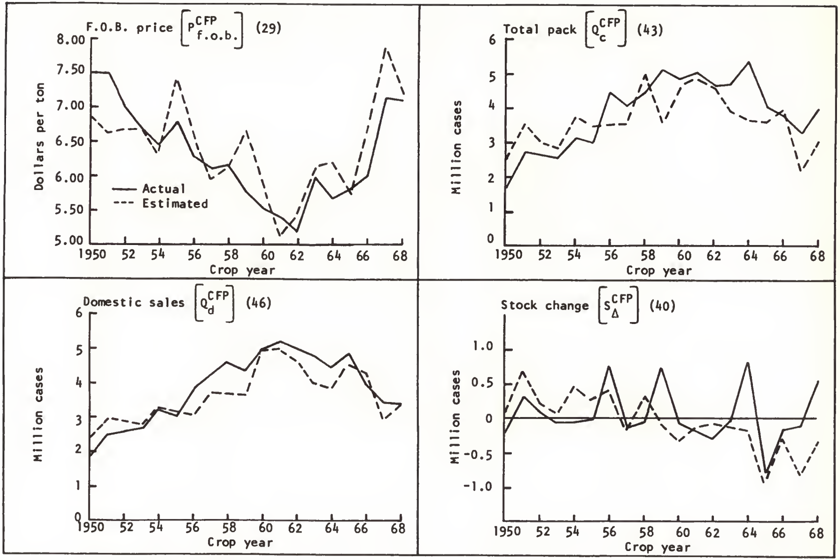


Figure 6. Canned Freestone Peaches: F.O.B. Price, Total Pack, Domestic Sales, and Stock Change, Actual and Estimated, 1950-68.

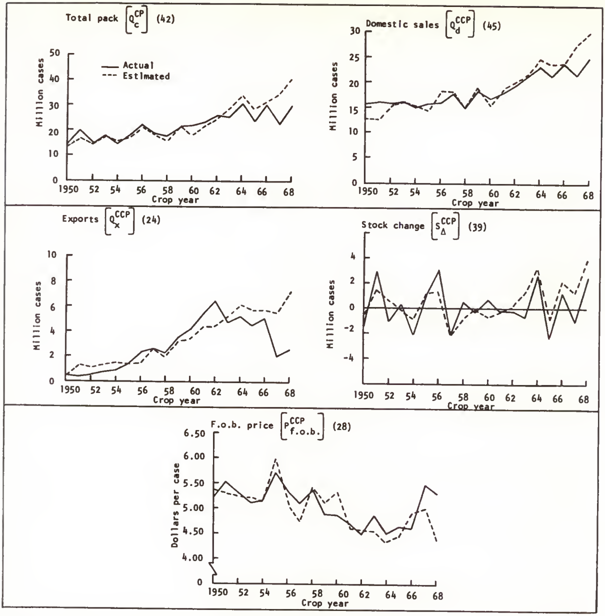


Figure 7. Canned Clingstone Peaches: F.O.B. Price, Total Pack, Domestic Sales, Exports, and Stock Change, Actual and Estimated, 1950-68.

markets. This is an important factor in underestimating prices in these markets. It should be noted that in 1958 a negative quantity is estimated for the drying apricot market, but that, in following years, the model operated fairly satisfactorily. It will therefore be important to reappraise these results with further observations and probably to recalculate coefficients of the model if it is to be used as a short-term predictive device.

Processor Level Demand for Canned Fruit

There are 14 endogenous variables in the canned fruit sector including prices for apricots, clingstone peaches, and freestone peaches; there are 11 quantities including total pack, domestic sales, and exports for three fruits. The actual and predicted values for apricots are given in Figure 5; those for canned freestone peaches in Figure 6; and those for canned clingstone peaches in Figure 7. Results are generally satisfactory for the period of the sample that extends through 1966, and for the predictions for freestone peaches for 1967 and 1968. For the predictions of canned apricots and clingstone peaches, a similar problem exists as was discussed for the raw fruit allocation above, namely, that the quantities allocated to the canning market are too high.

Note that for apricots in Figure 2 the quantity sold for canning, Q_P^{CA}, is expressed in terms of tons of raw product, and this variable was overestimated for 1967 and 1968. In Figure 5, the total pack of apricots, Q_C^A, is expressed in terms of million cases. Although these two variables are highly correlated, they differ from year to year and over time due to the pack out from a given supply of raw product. Thus, they are entered as two separate endogenous variables. The total pack is overestimated and with this quantity allocated to domestic sales, exports, and stock change, these variables also are higher than actual values. The price, therefore, is underestimated as is seen in Figure 5. We suggest that it is possible to obtain revised estimates for the quantity sold for canning and to revise downward the estimated total pack accordingly. This would then allow the use of the structural equations to estimate the price and

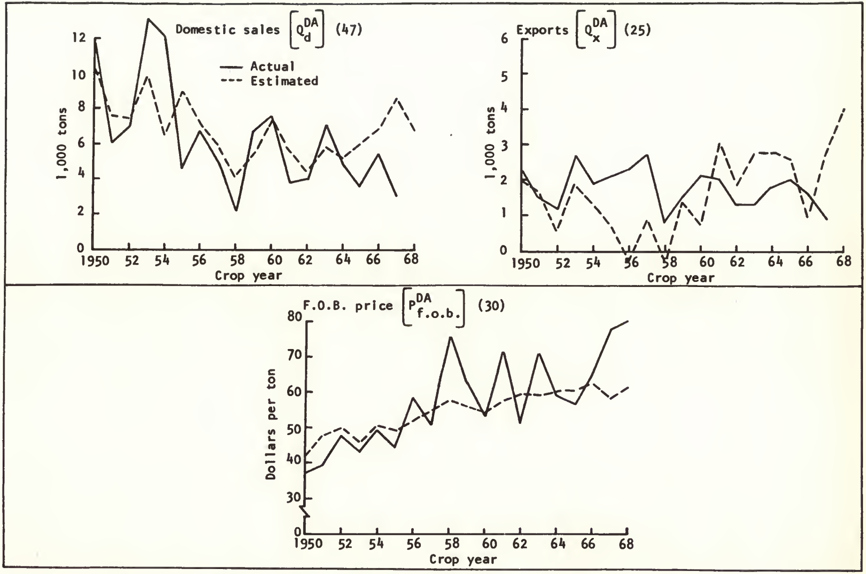


Figure 8. Dried Apricots: Domestic Sales, Exports, and F.O.B. Price, Actual and Estimated, 1950-68.

sales of fruit in the several outlets of canned fruit. A similar set of comments applies to canned clingstone peach projections.

Processor Level Demand for Dried Fruit

The dried fruit sector includes six endogenous variables including f.o.b. prices for dried apricots and for dried freestone peaches, and exports and domestic sales for the two fruits. This sector of the model is not completely specified since data on stocks are not readily available. The sum of domestic sales and exports (dried basis) should correspond to the dried equivalent of the raw fruit allocated to the drying market. Inspection of Figure 9 for apricots indicates that the estimates from the reduced-form matrix have considerable error in the sample years plotted as well as the predictions for 1967 and 1968. Further research is needed to tie in the estimates of domestic and export sales with the farm-level allocation procedure noted above. One approach might be to reformulate the model by sector, such as the drying market, and give more attention to alternative estimation procedures than is feasible with the 50-equation model. Some aspects of the model appear to be recursive in nature and require the incorporation of price expectations at the decision point when fruit is sold for canning or is placed on drying trays rather than the simultaneous equation system specified here. It should be noted that major concern should be directed to the major outlet of canned fruit for both freestone peaches and apricots. Inspection of the Appendix Tables A-1 and A-2, which present the supply and allocation of these fruits from 1924 to 1968, shows the change in the relative importance of the market outlets over time. An analysis of only the postwar data may well provide improved predictive accuracy of the submodels. Due to the large number of variables in the complete model, it appeared advisable to include all observations in this study. The estimates for dried freestone peaches are given in Figure 9, with results comparable to those for apricots.

Processor Level Demand for Frozen Fruit

Figure 10 gives actual and estimated prices for frozen apricots and frozen peaches and estimated domestic sales for each. The

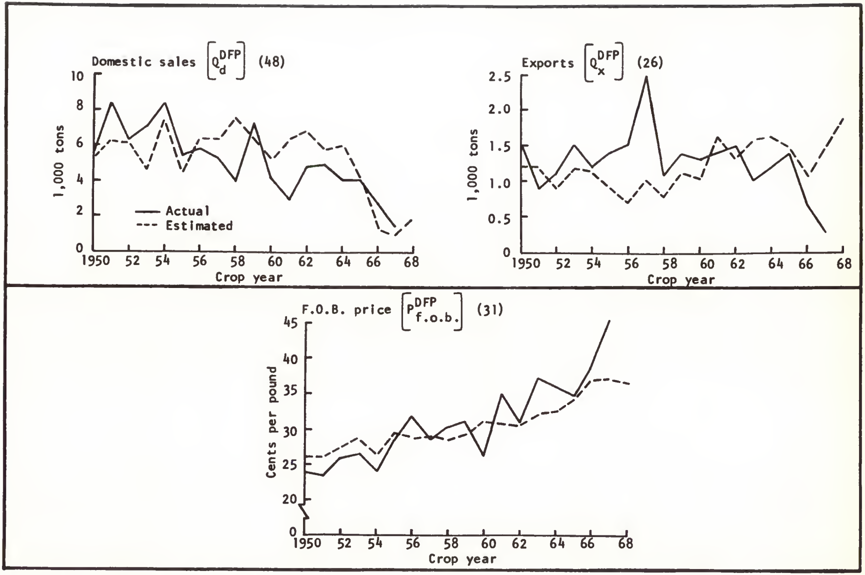


Figure 9. Dried Freestone Peaches: Domestic Sales, Exports, and F.O.B. Price, Actual and Estimated, 1950-68.

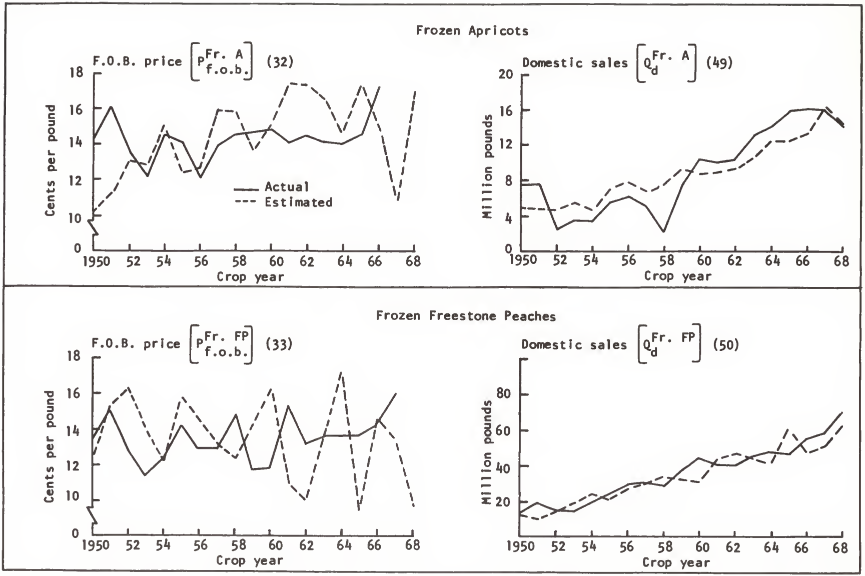


Figure 10. Frozen Apricots and Freestone Peaches: F.O.B. Prices and Domestic Sales, Actual and Estimated, 1950-68.

estimates of domestic sales are more satisfactory than for prices. This suggests that it might be desirable to consider a respecification of equations 17 and 18 with price for each fruit expressed as a function of quantities of the two frozen fruits. This would parallel the respecification of equations (1-11) to (1A-11A), which resulted in improved predictive accuracy of the model.

Eastern Auction Prices for Fresh Fruit

The last four endogenous variables are plotted in Figure 11, including fresh apricots, freestone peaches, nectarines, and plums. Major concern is for the 1967 and 1968 projections for fresh plums since earlier years included in the sample were generally satisfactory. Here again, it would appear desirable to continually update the estimates of the demand coefficients as more recent information becomes available.

In summary, the short-term projections leave much to be desired. Suggestions have been made for possible modifications of the model and for inclusion of observations for recent years as they become available. We turn next to long-run projections for 1980 that are developed on a different basis, and are conditional on the validity of the assumptions introduced.

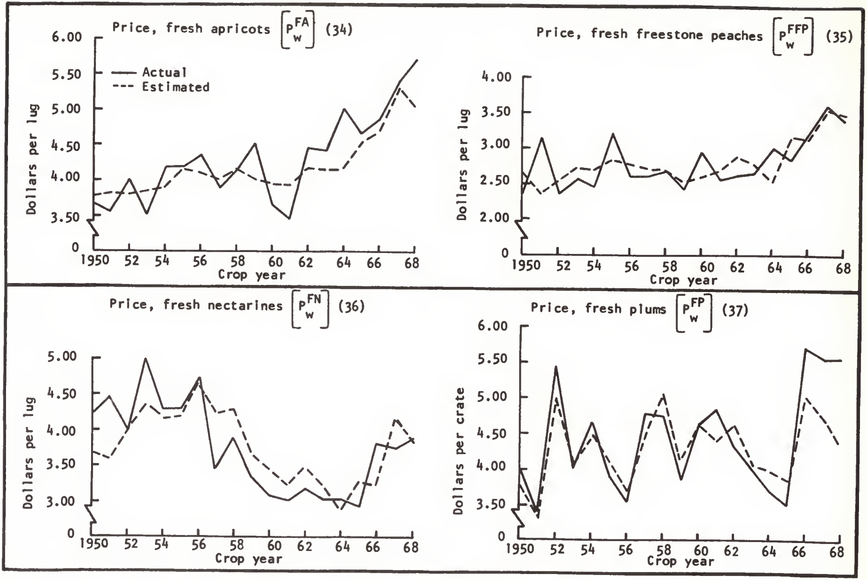


Figure 11. Eastern Auction Prices for Fresh Fruit: Actual and Estimated, 1950-68.

PROJECTIONS OF DEMAND FOR 1980 WITH IMPLICATIONS FOR PRODUCTION IN THE SAN JOAQUIN VALLEY

Production of deciduous tree fruits is one of the alternatives being considered for introduction on newly irrigated land in the San Joaquin Valley. What impact will new plantings have on the California deciduous fruit industry? This section provides some information on this question based on estimates of the expected level of demand for selected deciduous tree fruits in 1980; the expected yields of these crops; the acreage required to meet the expected level of sales under given yields and prices; and the implications of increased plantings on the industry located in various areas of the State.

Demand Projections for 1980

The estimated demand relationships presented previously provide the basis for projections of sales of fruit, by outlet, at specified prices. Since interest focuses on farm-level supply and demand, relationships (1-11) shown in Table 3 are used in projecting sales. Major demand shifters are total disposable personal income and a trend variable that is used as a proxy variable for changing tastes and preferences. As noted previously, it is practically impossible to obtain from time-series data completely acceptable coefficients associated with income and trend due to the high degree of correlation between these variables. The projections are subject to limitations in long-term extension beyond the period of observation of sample data. These appear to be the most acceptable estimates currently available, but undoubtedly are subject to high error of estimates. These are conditional projections of demand, with variables other than prices, income and trend held at 1961-65 levels. The trend variable T is 57 for 1980. The index of total disposable income is 407 for 1980, with base of 100 for 1947-49. Estimates of sales are made for four different price assumptions: (1) all prices are set at average values for 1961-65; (2) all prices are reduced by 10 percent; (3) the price of the particular fruit in a given outlet is reduced by 10 percent with other prices held at the 1961-65 average (e.g., the price of fresh apricots is reduced by 10 percent and the prices of other fresh fruits are held at 1961-65 levels); and (4) the price of the particular fruit in a given outlet is reduced by 20 percent.

Apricots

Estimates of demand functions for canned, frozen, fresh, and dried apricots are given in Figure 12 for the base period and for three of the alternative price specifications for 1980. Consider the demand function for canned apricots. This relationship is obtained by calculating price-quantity values for canned apricots with other variables in Equation 5 (Table 3) taken at 1961-65 average values. Since we are interested in change from the base period, estimated values for the base period rather than actual quantities are plotted. At the 1961-65 price of $91.00 per ton, the estimated quantity sold is 111.2 thousand tons, giving point A on the base period demand curve. The elasticity of demand at point A is -0.7 indicating that a 10-percent change in price is associated with a 7-percent change in quantity sold. An elasticity of less than one indicates that gross returns will be reduced with increased production and the associated lower price.

If prices are held at the 1961-65 level and the effect of total disposable income and trend to 1980 are estimated from Equation 5 (Table 3), we obtain point B on the 1980 demand curve. Sales of canned apricots are estimated to increase 15.0 thousand tons by 1980 over 1961-65 if prices were to remain at 1961-65 levels. Assuming that the shift in the demand curve is relatively accurate, we can proceed to explore the effect of lower prices on the quantity sold. Point D reflects the quantity sold, 135.3 thousand tons, if price of canned apricots is reduced by 10 percent to $81.90 per ton, and prices of other canned fruits were to remain at 1961-65 levels. Point E indicates the quantity sold (144.5 thousand tons) if price is reduced by 20 percent to $72.80 per ton. Estimate C is shown only in Table 11 for which prices of canned apricots and also prices of canned clingstone and freestone

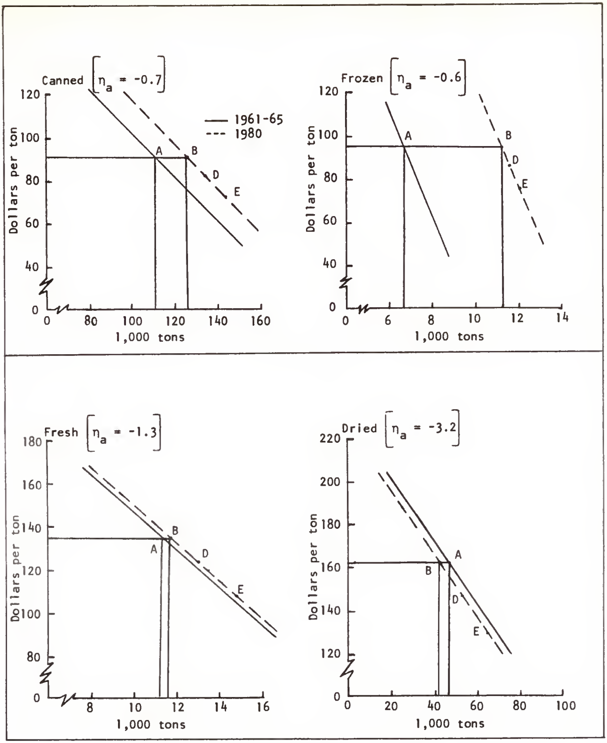


Figure 12. Demand for Apricots, 1961-65 and Estimated 1980 (Based on time trend and income effects with all other variables held at 1961-65 levels).

TABLE 11

Projected Sales of Selected Fruits, 1961-65, and Estimates for 1980 Based on Alternative Price Assumptions

Fruit and outlet	1961-65 quantity sold		1980 estimate based on income and trend effects[a]				
			All prices at 1961-65 average		All prices reduced by 10 percent	Own prices reduced by	
	Actual	Estimated[b]	1961-65 prices	1980 quantities		10 percent	20 percent
	1,000 tons		Dollars/ton	1,000 tons			
		A		B	C	D	E
Apricots							
Fresh	11.9	11.2	134.4	11.5	11.4	13.1	14.7
Canned	129.4	111.2	91.0	126.2	133.3	135.3	144.5
Dried	35.5	46.3	162.8	42.4	41.7	53.7	65.0
Frozen	7.1	6.7	95.0	11.3	11.7	11.7	12.1
Total	183.9	175.4		191.4	198.1	213.8	236.3
Freestone peaches							
Fresh	114.9	114.8	64.4	139.3	140.8	149.5	159.9
Canned	127.8	112.8	48.8	148.7	148.4	151.8	154.9
Dried	35.5	38.8	67.2	28.6	33.7	39.7	50.8
Frozen	30.0	23.3	52.4	36.8	39.5	39.7	42.7
Total	306.2	289.7		353.4	362.4	380.7	408.3
Clingstone peaches							
Canned	673.1	637.7	63.0	856.2	891.1	890.3	924.4
Nectarines							
Fresh	58.7	58.4	97.4	82.8	84.8	89.0	95.2
Plums							
Fresh	91.4	93.2	128.4	115.3	120.9	121.0	126.8

a/ Based on equations 1-11, Table 3. Per capita disposable income, in 1964 dollars, is projected by Daly and Egbert [1966] to increase from $2,261 in 1964 to $3,261 in 1980. The Census Series C population projection for 1980 is 235.2 million as compared with 192.1 million in 1964. Total disposable income is thus projected at $767.1 million (1964 dollars) giving an index of 407 with the base period 1947-49. The trend variable T is 57 for 1980.

b/ Obtained by estimating quantities in equations 1-11 using average 1961-65 values of variables.

peaches are reduced by 10 percent. This estimate includes allowance for the demand interrelationships among several products. Only 133.3 thousand tons would be sold if all three prices are reduced by 10 percent, as compared with 135.3 thousand tons if only apricot prices were reduced by 10 percent. Estimate C cannot be plotted conveniently since other factors, namely, canned peach prices, are not held constant. However, estimate C is important to keep in mind in interpreting the implications of higher levels of production on price since these fruits tend to be substitutes in competing for consumer expenditures.

Similar comments and interpretations can be made for apricots sold in other market outlets. Note that for dried apricots, the demand function for 1980 lies to the left of that for 1961-65, reflecting the declining sales of this fruit over time.

Total apricot sales are projected to increase by 26.0 thousand tons under 1961-65 price assumptions, and by higher quantities if prices are lower (expressed in terms of 1961-65 dollars). The relevant price for 1980 depends on the production both of apricots and competing fruits which in turn depends on bearing acreages and yields. We return to this question after presenting a brief discussion of the demand for the other fruits.

Freestone Peaches

Freestone peaches also are sold in four market outlets, with fresh and canned being the most important for the base period and for projected 1980 sales. At the 1961-65 farm level price of $64.40 per ton for fresh sales, quantities sold are estimated at 111,200 tons for the base period. The elasticity of demand for fresh sales (at point A in Figure 13) is -0.9, indicating a 9 percent increase in sales with a 10-percent decrease in price, other factors constant. For 1980, fresh sales are estimated to increase by 24.5 thousand tons with constant 1961-65 prices (point B), and by correspondingly larger quantities under alternative price assumptions as shown in Table 11.

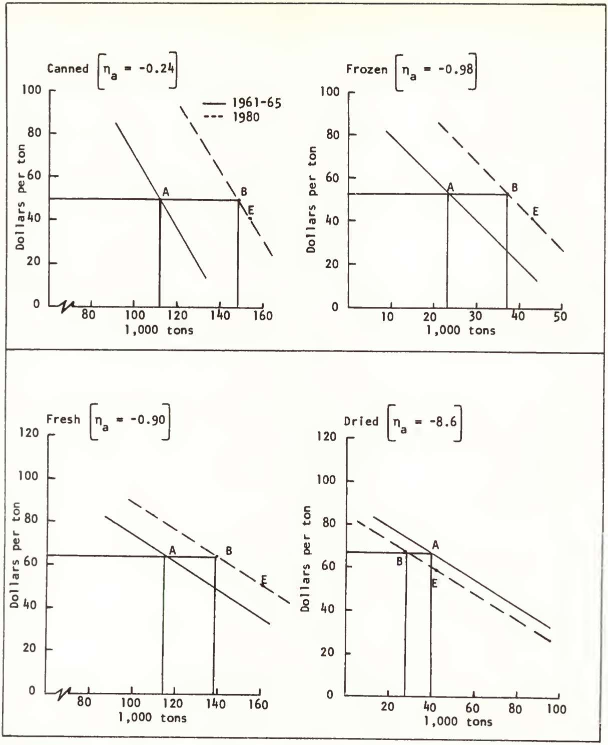


Figure 13. Demand for Freestone Peaches, 1961-65 and Estimated 1980 (Based on time trend and income effects with all other variables held at 1961-65 levels).

Sales of freestone peaches for canning are estimated to increase by 35.9 thousand tons under the constant price assumption (point B). The estimated elasticity of demand at point A is -0.24 which is considerably lower than for apricots and clingstone peaches. Sales of dried freestone peaches are projected to be lower than in 1961-65 under price assumption B whereas sales for freezing are projected to increase for all price assumptions.

Clingstone Peaches

Clingstone peaches are sold primarily for canning. Estimates of the demand function for canning peaches at the farm level is shown in Figure 14. At the 1961-65 price of $63 per ton, sales are estimated at 638 thousand tons for the base period (point A). Elasticity of demand at this point is -0.5, indicating a 10-percent decrease in the price of canning peaches will result in a 5-percent increase in sales, with other variables held constant. The gross income, however, would be lower with increased sales. As for apricots, point B represents 1980 estimated sales at this price with the increase due to trend and income effects. Point D represents sales with a 10-percent reduction in price and point E represents sales with a 20-percent reduction, with other prices constant. Estimate C, with all prices reduced by 10 percent, is given in Table 11.

Plums

The farm level demand for fresh plums is less elastic than for other fresh fruits considered, with an elasticity of -0.6 at the 1961-65 mean values. The price-quantity relation is plotted in Figure 14 for the base period with price at $128.40 per ton and the estimated sales of 93.2 thousand tons. For 1980, sales are projected to increase to 115,300 tons with constant prices (point B) and with higher sales with lower prices. A supply response analysis would be useful in estimating the probable level of production and, thus, price in 1980. However, we must be satisfied with a simpler approach in the following section.

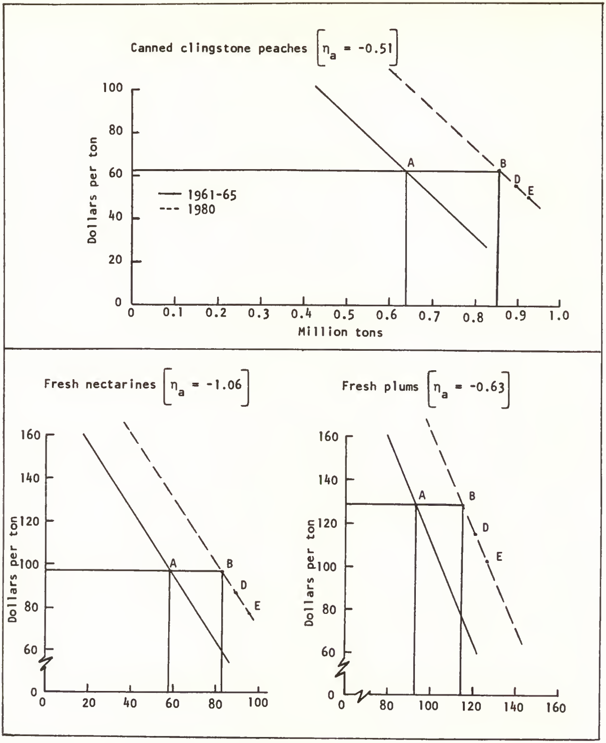


Figure 14. Demand for Canned Clingstone Peaches, Fresh Nectarines, and Fresh Plums, 1961-65 and Estimated 1980 (Based on time trend and income effects with all other variables held at 1961-65 levels).

Nectarines

Nectarines are sold primarily for fresh use. Estimates of the demand functions for fresh nectarines are given in Figure 14 for the base period and for 1980. The farm level demand for fresh nectarines is considerably more elastic than for other fresh fruits considered, with an elasticity of -1.06 at the 1961-65 mean values (point A). As for other fruits, point B represents 1980 estimated sales at 1961-65 average price with the increase due to trend and income effects. Points D and E represent 1980 estimated sales with 10- and 20-percent reductions in price, respectively, with other prices constant.

Estimated Bearing Acreage and Yields in 1980

For deciduous fruit, "production of value" exceeds "sales" by a certain amount; also, the sales to minor outlets have not been included in the previous estimates. We have provided estimates of "production required to meet sales" both for the base period and for 1980 corresponding to the alternative price estimates. This was accomplished by increasing sales estimates given in Table 11 by certain percentages (see footnote to Table 12) to account for sales to minor outlets which were not included in previous estimates.

In the base period, 161,938 bearing acres were reported by the California Crop and Livestock Reporting Service [1968] for these five fruits. Estimate B_1 indicates the required bearing acreage in 1980 if yields were to remain at the 1961-65 level, a most unlikely situation. Estimates B, C, D, and E all are based on estimated higher yields in 1980 and the alternative price assumptions noted previously.

Assume that prices remain at the 1961-65 level (model B). Aggregate production is projected to increase by 22 percent (1,406,400 to 1,716,000 tons) but due to higher yields the required bearing acreage is reduced by 3.5 percent (161,938 to 156,176 acres). Increased acreage for clingstone peaches, nectarines, and plums is more than offset by projected reductions for apricots and freestone peaches.

TABLE 12

Estimated Bearing Acreage and Yields in 1980 Associated with Production to Meet Estimated Sales at Specified Prices

Fruit	Unit	Base period	1980 estimates with higher population and income, and					
			Base period yields and prices	Projected 1980 yields and				
				1961-65 prices	All prices 10% lower	Own price 10% lower	Own price 20% lower
		A	B_1	B	C	D	E
Apricots							
Production to meet sales at specified prices[a/]	1,000 tons	190.8	198.5	198.5	205.5	221.8	245.1
Yield per acre	Tons	5.24	5.24	6.63	6.63	6.63	6.63
Bearing acreage							
Estimated	Acres	36,434	37,882	29,940	30,995	33,454	36,968
Change from 1961-65	Acres	--	+ 1,448	- 6,494	- 5,439	- 2,980	+ 534
Clingstone peaches							
Production to meet sales at specified prices[b/]	1,000 tons	746.8	950.0	950.0	988.7	987.8	1,025.6
Yield per acre	Tons	12.89	12.89	16.0	16.0	16.0	16.0
Bearing acreage							
Estimated	Acres	57,938	73,701	59,375	61,794	61,738	64,100
Change from 1961-65	Acres	--	+ 15,763	+ 1,437	+ 3,856	+ 3,800	+ 6,162
Freestone peaches							
Production to meet sales at specified prices[c/]	1,000 tons	307.4	354.8	354.8	363.8	382.2	409.9
Yield per acre	Tons	8.98	8.98	11.0	11.0	11.0	11.0
Bearing acreage							
Estimated	Acres	34,223	39,510	32,255	33,073	34,745	37,264
Change from 1961-65	Acres	--	+ 5,287	- 1,968	- 1,150	+ 522	+ 3,041
Nectarines							
Production to meet sales at specified prices[d/]	1,000 tons	60.8	85.8	858	87.8	92.2	98.6
Yield per acre	Tons	6.59	6.59	8.61	8.61	8.61	8.61
Bearing acreage							
Estimated	Acres	9,227	13,020	9,965	10,197	10,708	11,452
Change from 1961-65	Acres	--	+ 3,793	+ 738	+ 970	+ 1,481	+ 2,225
Plums							
Production to meet sales at specified prices[e/]	1,000 tons	100.6	126.9	126.9	133.1	133.2	139.6
Yield per acre	Tons	4.17	4.17	5.15	5.15	5.15	5.15
Bearing acreage							
Estimated	Acres	24,116	30,432	24,641	25,845	25,864	27,107
Change from 1961-65	Acres	--	+ 6,316	+ 525	+ 1,729	+ 1,748	+ 2,991
Total							
Production	1,000 tons	1,406.4	1,716.0	1,716.0	1,778.9	1,817.2	1,918.8
Bearing acreage	Acres	161,938	194,545	156,176	161,904	166,509	176,891
Change from 1961-65	Acres	--	+ 32,607	- 5,762	- 34	+ 4,571	+ 14,953

[a/] Production estimated at 103.75 percent of sales shown in Table 13, as in 1961-65.

[b/] Production estimated at 110.95 percent of sales for canning shown in Table 13, as in 1961-65.

[c/] Production estimated at 100.39 percent of sales shown in Table 13, as in 1961-65.

[d/] Production estimated at 103.58 percent of fresh sales shown in Table 13, as in 1961-65.

[e/] Production estimated at 110.07 percent of fresh sales shown in Table 13, as in 1961-65.

Similar statements can be made concerning the other price estimates, but, in general, the increased sales with lower prices will require increased levels of bearing acreages with the assumed 1980 yield level.

Another way of looking at these results is to indicate that if 1980 bearing acreage, yields, and crop market allocations correspond to those of model C, for example, we will expect that all prices will be 10 percent below those in 1961-65 (expressed in 1961-65 dollars). The next question concerns the impact of new plantings on the industry.

Location of Production

Currently, California produces almost 100 percent of United States production of clingstone peaches and nectarines, 95 percent of apricot production, 90 percent of plum production, and 25-30 percent of freestone peach production. Acreage and production of these five fruits is concentrated mainly in three areas--Central Coast, Sacramento and San Joaquin Valleys, and with smaller acreage located in the Sierra Nevada foothills and in Southern California areas. The 1961-65 location by major producing districts of the bearing and nonbearing acreages of these five fruits is summarized in Table 13.

The acreage of deciduous tree fruits, especially those included in this study, has been shifting to the San Joaquin Valley, as shown in a recent report on trends by Johnston and Dean [1969]. This shift also is reflected in data shown in the last column of Table 15 that indicate the importance of the San Joaquin Valley especially in the category of nonbearing acreage as well as bearing acreage in that period.

Based on the trends in the shift in location of production, we estimate that by 1980 the distribution of acreage may be as follows: Apricots--50 percent in the San Joaquin Valley, 30 percent in the Central Coast, and 20 percent in the Sacramento Valley. The acreage located in Southern California is estimated to no longer be in production by 1980.

TABLE 13

Bearing and Nonbearing Acreages, 1961-65 Average, for Selected Deciduous Fruits by Major Producing Districts in California

Item	Producing district					Total California	Relative importance of San Joaquin Valley
	San Joaquin Valley 5A	Sacramento Valley 5	Central Coast 4	Sierra Mountain 6	Southern California 8		
	Acres						Percent
Apricots							
Bearing	8,821	6,029	19,470	9	2,105	36,434	24
Nonbearing	2,965	600	1,207	1	326	5,099	58
Total	11,786	6,629	20,677	10	2,431	41,533	28
Clingstone peaches							
Bearing	36,998	20,095	83	632	125	57,938	64
Nonbearing	11,809	6,963	6	97	2	18,878	63
Total	48,807	27,058	89	729	127	76,816	64
Freestone peaches							
Bearing	27,542	4,468	371	354	1,424	34,223	80
Nonbearing	3,170	254	35	121	206	3,787	84
Total	30,712	4,722	406	475	1,630	38,010	81
Nectarines							
Bearing	9,021	46	62	4	95	9,227	98
Nonbearing	959	54	4	2	16	1,036	93
Total	9,980	100	66	6	111	10,263	97
Plums							
Bearing	16,100	1,705	802	4,878	623	24,116	67
Nonbearing	4,176	303	106	441	55	5,082	82
Total	20,276	2,008	908	5,319	678	29,198	69
Total, five fruits							
Bearing	98,482	32,343	20,788	5,877	4,372	161,938	61
Nonbearing	23,079	8,174	1,358	662	605	33,882	68
Total	121,561	40,517	22,146	6,539	4,977	195,820	62

Source: State totals are from California Crop and Livestock Statistics (1968). Regional data are from compilations from unpublished data from the *California Crop and Livestock Reporting Service*, and reported by Johnston and Dean (1969).

Cling Peaches--Proportions of total acreage located in Sacramento and San Joaquin valleys are almost stabilized. The 2 percent of total acreage located in other areas will shift to the San Joaquin Valley and 1980 location of total acreage will be 65 percent in San Joaquin Valley and 35 percent in Sacramento Valley.

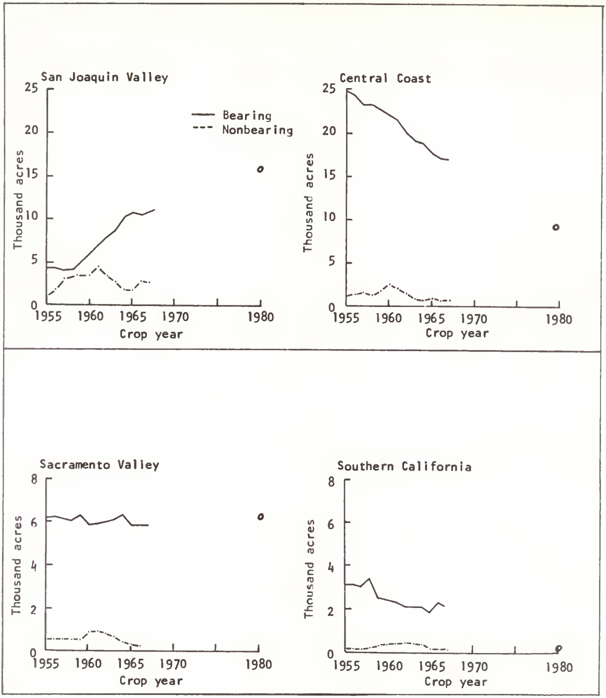
Freestone Peaches--Very small acreages in the Central Coast and Sierra Mountain foothill areas will shift to the San Joaquin Valley. The 1980 location will be 84 percent San Joaquin Valley, 12 percent Sacramento Valley, and 4 percent Southern California.

Nectarines--97 percent of total acreage was located in the San Joaquin Valley in 1961-65. It can be expected that nectarines will be an exclusively San Joaquin crop by 1980.

Plums--Plums are also shifting very rapidly to San Joaquin Valley because of the earliness of harvest and higher yields in the southern San Joaquin Valley. It is assumed that 90 percent of acreage will be located in the San Joaquin Valley, 4 percent in the Sacramento Valley, and 6 percent in the Sierra Mountain region.

The trends in the regional bearing and nonbearing acreages of the five fruits are given in Figures 15 to 18. The estimated acreage by region for 1980 requires careful consideration as to how it was derived. The demand for 1980 was estimated using the assumption that prices for own and substitute fruits would decrease by 10 percent from the 1961-65 level (1961-65 dollars) due to increased production efficiency. A lower acreage projection would be made if 1961-65 prices were used, and a higher acreage projection would be associated with lower prices (models D and E). These State production levels are summarized in the last column of Table 14. The regional production levels are then calculated using the percentage distribution discussed above. Bearing acreages by region are calculated similarly, with the simplifying assumption of equal yields in all regions. The last section of Table 14 indicates the change in acreage, by region, from the 1961-65 base period.

There is a marked change in the regional distribution in acreage projected for 1980. However, the aggregate bearing acreage for the five fruits is about equal to that for the 1961-65 period. Essentially, the increased yields offset the higher demand levels. This


San Joaquin Valley

Central Coast

Sacramento Valley

Southern California

Figure 15. Apricots: Bearing and Nonbearing Acreage by Region in California, 1955-68 and 1980 Acreage Consistent with Projected Demand (Model C).

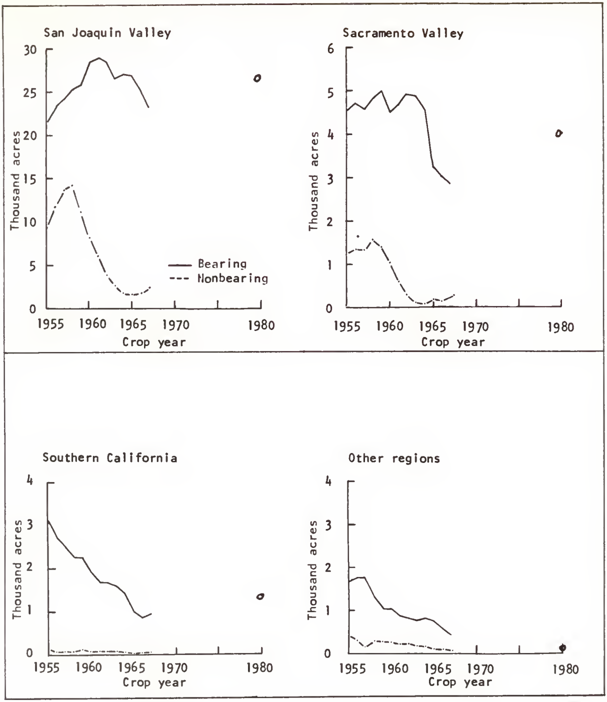
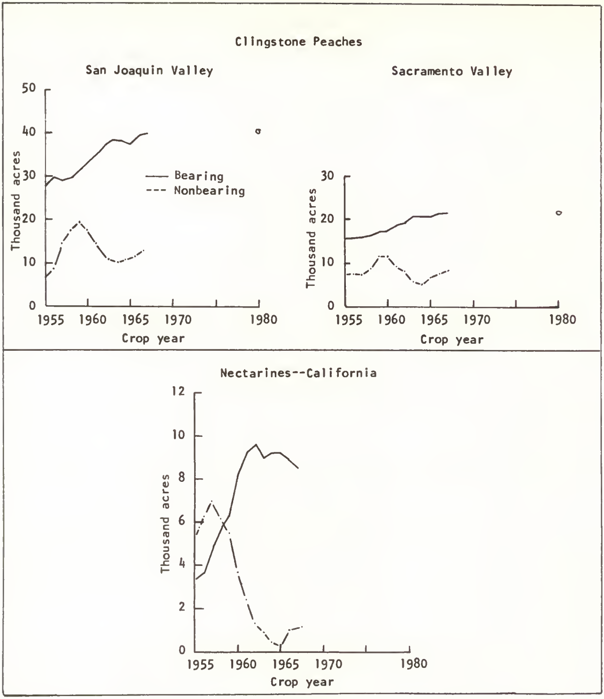


Figure 16. Freestone Peaches: Bearing and Nonbearing Acreage by Region in California, 1955-68, and 1980 Acreage Consistent with Projected Demand (Model C).



Clingstone Peaches

San Joaquin Valley

Sacramento Valley

Nectarines--California

Figure 17. Clingstone Peaches and Nectarines: Bearing and Nonbearing Acreage by Region in California, 1955-68 and 1980 Acreage Consistent with Projected Demand (Model C).

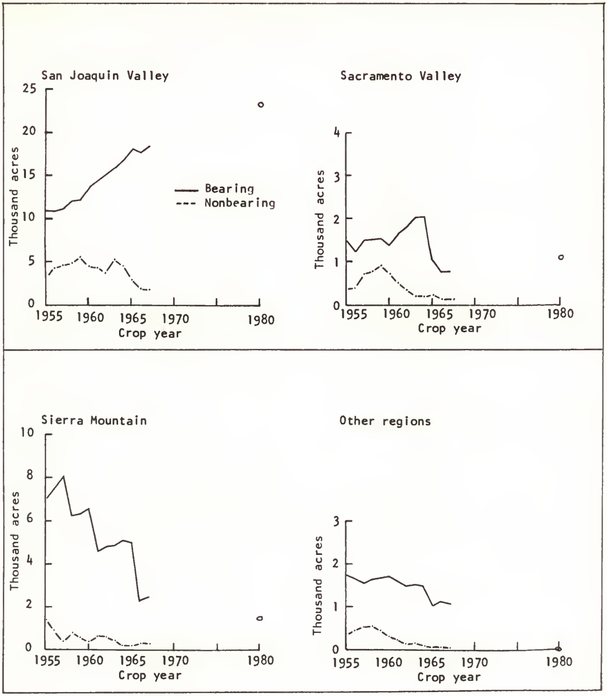


Figure 18. Plums: Bearing and Nonbearing Acreage by Region in California, 1955-68, and 1980 Acreage Consistent with Projected Demand (Model C).

TABLE 14

Projected Regional Production and Bearing Acreage in 1980 Assuming Model C Conditions as to Yield and Prices for the State and Estimated Regional Distribution of Production[a]

Item	Region					Total 1980
	San Joaquin Valley	Sacramento Valley	Central Coast	Southern California	Other	
	1,000 tons					
Production						
Apricots	102.8	41.1	61.6	--	--	205.5
Clingstone peaches	642.7	346.0	--	--	--	988.7
Freestone peaches	305.6	43.6	--	14.6	--	363.8
Nectarines	87.8	--	--	--	--	87.8
Plums	119.8	5.3	--	--	8.0[b]	133.1
Total	1,258.7	436.0	61.6	14.6	8.0	1,778.9
	Acres					
Bearing acreage 1980						
Apricots	15,498	6,199	9,298	--	--	30,995
Clingstone peaches	40,166	21,628	--	--	--	61,794
Freestone peaches	27,781	3,969	--	1,323	--	33,073
Nectarines	10,197	--	--	--	--	10,197
Plums	23,260	1,029	--	--	1,556 [b]	25,845
Total	116,902	32,825	9,298	1,323	1,556	161,904
Change from 1961-65						
Apricots	+ 6,677	+ 170	-10,172	-2,105	- 9	- 5,439
Clingstone peaches	+ 3,168	+ 1,533	- 82	- 125	- 638	+ 3,856
Freestone peaches	+ 239	- 499	- 371	- 101	- 418	- 1,150
Nectarines	+ 1,177	- 46	- 62	- 95	- 4	+ 970
Plums	+ 7,160	- 676	- 802	- 623	-3,330	+ 1,729
Total	+ 18,421	+ 482	-11,489	-3,049	-4,399	- 34

[a] State total production consistent with 1980 projected yields and all prices 10 percent lower than in 1961-65 (Model C assumptions as shown in Table 14). Regional distribution of production as discussed in the text. This distribution assumes equal yields in all regions.

[b] Includes Sierra Mountain Region of 1,553 acres.

varies by fruit, however. Acreage decreases are indicated for apricots and freestone peaches, whereas significant increases are projected for clingstone peaches, plums, and nectarines.

Implications of West Side San Joaquin Valley Production

At the present time, we do not have full information as to the extent of new plantings of these crops on the West Side. However, the above analysis should indicate the limits of expanded acreage that appears economically feasible between now and 1980. We have noted possible sources of error in our projections, including: (1) demand projections, (2) yield projections, and (3) regional acreage shifts. However, the framework presented is such that alternative estimates of yields and demand may be traced through readily.

Individual producers must keep in mind the market implications of increased levels of production. To reemphasize this point, the gross income for 1980 under alternative price and production assumptions is given below:

Price	Model	Gross income				
		Apricots	Freestone	Cling	Nectarines	Plums
		Million dollars				
1961-65 average	B	21.01	20.1	53.9	8.1	14.8
Own price -10%	D	21.53	19.6	50.5	7.8	14.0
Own price -20%	E	21.48	18.8	46.6	7.4	13.0
All prices -10%	C	19.41	18.6	50.5	7.4	14.0

A comparison of gross incomes under models B, D, and E indicates the inelastic nature of aggregate demand for these commodities; that is, a price reduction is associated with a less than proportionate increase in sales, resulting in lower gross income to the industry. The one exception is apricots (model B to D) due to the estimated elastic demand at farm level in the fresh market. Model C estimates differ from the other comparisons since competing prices as well as own prices are reduced by 10 percent. This model may be the most realistic, however, since all fruits compete for consumer purchasing power in each market outlet.

If we accept these estimates of market demand and yields, the bearing acreage required in 1980 for the State is determined. The question is, if acreage is introduced in the newly irrigated areas on the West Side, for example, what will be the implications for other producing areas in the State? We have noted that considerable acreage is projected to go out of the Central Coast and Southern California, and increases are possible for the San Joaquin and the Sacramento valleys. If the shifts in acreage are limited to relocations due to urban pressures and to relative demand among these five fruits, the amount of bearing acreage in 1980 should be approximately equal to that in 1961-65 for model C. If acreage in excess of this is introduced, the question of importance is the comparative advantage of regions within the State in fruit production. Detailed information is needed on the levels of cost per ton in current areas and in the new areas. It is clear that water costs are higher in the new areas on the West Side. Whether these costs can be offset by increased production efficiency is not clear. Estimates of water cost on the West Side are about $24 per acre-foot as compared with costs of about $3 per acre foot in areas on the East Side. If three acre-feet are required per acre, the additional cost per acre is $63. This amount must be offset by increased efficiency in production if the West Side production is to be maintained in the long run. Due to the limited potential expansion of bearing acreage projected in this study, the economic feasibility of new orchards should give full recognition to aggregate market implications of the effect of increased production on price.

APPENDIX A

APPENDIX TABLE A-1

Apricot Sales and Allocation by Markets

	Fresh					Canned				Dried		Frozen
		Farm allocation					Processor allocation			Allocation		
Marketing Year Beginning June 1	Total sales	Fresh	Canned	Dried (fresh basis)	Frozen	Total pack	U.S. sales	Exports	Stock change	U.S. sales	Exports	Total sales
	Q^{A}_{t}	Q^{FA}_{w}	Q^{CA}_{p}	Q^{DA}_{p}	$Q^{Fr.\ A}_{p}$	Q^{A}_{c}	Q^{CA}_{d}	Q^{CA}_{x}	S^{CA}_{Δ}	Q^{DA}_{d}	Q^{DA}_{x}	$Q^{Fr.\ A}_{d}$
	X_1	Y_1	Y_9	Y_{12}	Y_{14}	Y_{41}	Y_{44}	Y_{23}	Y_{38}	Y_{47}	Y_{25}	Y_{49}
	Thousand tons						Thousand cases			Thousand tons		Thousand lbs.
1924	134.5	11.5	35.0	88.0	0.0	1968.	1235.	716.	17.	9.5	6.5	0.
1925	147.4	10.8	37.6	99.0	0.0	2094.	1755.	633.	-294.	9.2	8.8	0.
1926	171.4	9.2	58.8	103.4	0.0	3227.	2038.	809.	380.	10.1	8.7	0.
1927	204.3	12.8	54.0	137.5	0.0	2960.	1779.	630.	551.	13.5	11.5	0.
1928	171.3	13.3	36.3	121.7	0.0	1991.	2195.	594.	-798.	10.0	12.1	0.
1929	210.1	15.4	73.1	121.6	0.0	4023.	2259.	729.	1035.	12.5	9.6	0.
1930	183.3	16.8	35.5	131.0	0.0	1954.	2183.	414.	-643.	11.9	11.9	0.
1931	267.7	24.2	36.5	207.0	0.0	2006.	1541.	496.	-31.	19.1	18.5	0.
1932	250.7	23.9	32.8	194.0	0.0	1805.	1521.	476.	-192.	18.5	16.8	0.
1933	266.1	16.2	43.9	206.0	0.0	2416.	2034.	538.	-156.	19.7	17.8	0.
1934	137.3	12.0	32.9	92.4	0.0	1774.	1477.	237.	60.	9.0	7.8	0.
1935	214.3	14.8	57.5	142.0	0.0	3164.	1951.	596.	617.	12.5	13.3	0.
1936	246.3	16.4	52.7	147.2	0.0	2899.	2992.	523.	-616.	18.0	14.2	0.
1937	309.3	19.3	101.0	189.0	0.0	5553.	2901.	575.	2077.	18.4	16.0	0.
1938	164.3	18.6	28.1	117.6	0.0	1547.	2562.	762.	-1777.	6.7	14.7	0.
1939	302.3	21.1	55.7	225.5	0.0	3338.	2640.	747.	-49.	25.2	15.8	0.
1940	101.3	13.0	30.0	58.3	0.0	1815.	2012.	13.	-210.	9.0	1.6	0.
1947	167.3	20.7	60.5	84.2	1.9	3063.	2415.	288.	360.	13.0	2.3	3171.
1948	191.3	20.9	101.5	68.2	0.7	4651.	3528.	254.	869.	9.2	3.2	3907.
1949	158.3	19.9	59.7	78.4	0.3	2307.	3072.	211.	-976.	12.3	2.0	2400.
1950	211.3	25.8	103.7	77.8	4.0	3661.	3942.	136.	-417.	11.9	2.3	7504.
1951	170.3	20.3	104.2	41.5	4.3	4538.	3906.	133.	499.	6.1	1.5	7760.
1952	156.3	17.4	92.5	45.3	1.1	3905.	3761.	112.	32.	7.0	1.2	2559.
1953	228.3	17.8	120.2	88.2	2.1	4718.	4179.	164.	375.	13.3	2.7	3748.
1954	138.3	12.6	87.1	36.6	2.0	2678.	3231.	246.	-799.	4.7	1.9	3610.
1955	251.3	15.8	151.5	79.0	5.0	5781.	4612.	215.	954.	12.3	2.1	5605.
1956	184.3	11.3	121.0	50.1	1.9	4118.	4000.	302.	-784.	6.8	2.3	6067.
1957	165.3	11.2	109.0	42.2	2.9	4004.	4050.	344.	-389.	5.0	2.7	5137.
1958	88.3	5.7	65.0	16.1	1.5	1718.	2079.	126.	-487.	2.1	0.8	2068.
1959	208.3	10.5	149.0	45.1	3.7	4885.	4225.	196.	464.	6.7	1.5	7209.
1960	223.8	11.3	152.0	53.2	7.3	5949.	4519.	246.	1185.	7.6	2.1	10478.
1961	161.3	11.1	112.4	32.5	5.3	4744.	4944.	387.	-587.	3.9	2.0	10338.
1962	152.8	10.3	108.0	28.9	5.6	3946.	3939.	173.	-166.	4.0	1.3	10590.
1963	188.8	10.9	123.0	47.9	7.0	4029.	4237.	180.	-388.	7.3	1.3	13128.
1964	206.9	13.0	148.0	37.4	8.5	5085.	4363.	137.	585.	4.8	1.8	14171.
1965	209.8	14.0	156.0	30.6	9.0	5138.	4998.	235.	-95.	3.6	2.0	15887.
1966	183.4	11.9	124.0	39.0	8.5	5018.	4978.	135.	-95.	5.5	1.6	16082.
1967	142.4	7.2	105.5	22.0	7.7	4213.	4201.	62.	-50.	3.1	0.9	15911.
1968	144.4	7.5	105.6	23.1	8.2	4513.	4394.	52.	66.	-0.0	-0.0	14033.

APPENDIX TABLE A-2

Freestone Peach Sales and Allocation by Markets

Marketing Year Beginning June 1	Fresh					Canned			Dried		Frozen
		Farm allocation					Processor allocation		Allocation		
	Total sales	Fresh	Canned	Dried (fresh basis)	Frozen	Total pack	U.S. sales	Stock change	U.S. sales	Exports	Total sales
	Q_t^{FP}	Q_w^{FFP}	Q_p^{CFP}	Q_p^{DFP}	$Q_p^{Fr.\ FP}$	Q_c^{FP}	Q_d^{CFP}	S_Δ^{CFP}	Q_d^{DFP}	Q_x^{DFP}	$Q_d^{Fr.\ FP}$
	X_3	Y_2	Y_{11}	Y_{13}	Y_{15}	Y_{43}	Y_{46}	Y_{40}	Y_{48}	Y_{26}	Y_{50}
	Thousand tons					Thousand cases			Thousand tons		Thousand lbs.
1924	203.6	34.4	22.4	146.8	0.0	935.	1030.	-95.	22.0	2.5	0.
1925	167.8	43.0	27.9	96.9	0.0	1063.	1027.	36.	14.3	1.9	0.
1926	222.2	34.1	19.0	169.1	0.0	498.	447.	51.	24.4	3.8	0.
1927	171.5	61.0	7.5	103.0	0.0	314.	296.	17.	13.6	3.6	0.
1928	214.7	41.9	3.8	169.0	0.0	157.	310.	-153.	21.6	6.6	0.
1929	153.5	44.1	9.1	100.3	0.0	376.	362.	14.	12.4	3.0	0.
1930	265.3	92.9	2.8	169.6	0.0	120.	145.	-25.	20.8	5.3	0.
1931	200.5	64.5	1.7	134.3	0.0	72.	82.	-10.	16.2	5.3	0.
1932	207.7	65.2	0.6	141.9	0.0	23.	40.	-17.	17.3	4.9	0.
1933	198.8	53.9	1.5	143.4	0.0	65.	64.	0.	18.8	4.6	0.
1934	189.0	48.9	7.9	132.2	0.0	340.	321.	19.	21.8	4.0	0.
1935	155.0	44.1	8.5	102.4	0.0	365.	274.	91.	15.4	4.1	0.
1936	192.0	56.8	11.0	124.2	0.0	475.	518.	-43.	22.3	4.1	0.
1937	204.0	62.2	24.3	117.5	0.0	1043.	677.	366.	19.6	4.4	0.
1938	195.0	66.8	9.4	118.8	0.0	376.	542.	-166.	16.7	5.5	0.
1939	229.0	77.5	21.5	130.0	0.0	882.	878.	4.	21.1	3.8	0.
1940	230.0	79.8	27.7	122.5	0.0	1134.	1233.	-99.	23.3	1.1	0.
1947	271.0	117.3	40.3	110.5	2.9	1497.	1291.	247.	16.1	1.0	4988.
1948	218.0	113.6	50.2	51.6	2.6	1708.	1690.	17.	5.6	2.5	7175.
1949	253.0	111.3	44.5	91.6	5.6	1499.	1493.	6.	13.5	0.8	9382.
1950	228.0	118.1	54.0	46.0	9.9	1677.	1896.	-219.	5.7	1.6	14187.
1951	260.0	106.4	80.2	59.7	13.7	2792.	2471.	322.	8.4	0.8	19379.
1952	258.0	119.7	79.3	48.2	10.8	2670.	2579.	91.	6.4	1.1	15057.
1953	246.0	105.6	74.0	55.7	10.7	2580.	2648.	-68.	7.1	1.5	14888.
1954	276.0	117.0	85.3	62.1	11.6	3113.	3170.	-50.	8.4	1.2	19514.
1955	272.0	127.0	81.2	44.7	18.5	3007.	3025.	-18.	5.5	1.4	25343.
1956	287.4	109.7	109.6	43.3	20.8	4493.	3739.	754.	5.8	1.5	30039.
1957	289.8	123.4	94.3	50.5	21.6	4065.	4181.	-116.	5.3	2.5	31212.
1958	276.8	105.7	118.9	32.9	19.3	4489.	4580.	-91.	4.0	1.1	29980.
1959	320.8	111.7	129.3	56.0	23.8	5117.	4369.	748.	7.2	1.4	37694.
1960	296.8	117.4	109.6	35.8	34.0	4876.	4935.	-59.	4.2	1.3	44472.
1961	299.8	112.8	129.3	28.9	28.8	5028.	5187.	-159.	3.0	1.4	41656.
1962	308.8	120.0	122.0	41.2	25.5	4694.	4965.	-271.	4.8	1.5	41218.
1963	306.8	117.0	132.0	38.3	29.3	4722.	4747.	-25.	4.9	1.0	46131.
1964	326.8	116.9	137.5	33.7	38.7	5366.	4481.	885.	4.0	1.2	48028.
1965	288.8	108.0	118.0	35.3	27.5	4072.	4824.	-752.	4.0	1.4	46353.
1966	257.2	102.2	99.0	22.0	34.0	3814.	3982.	-168.	2.7	0.7	55800.
1967	205.2	71.2	82.0	12.0	40.0	3307.	3413.	-106.	1.4	0.3	58989.
1968	249.1	83.0	103.0	18.3	44.8	3896.	3386.	600.	-0.0	-0.0	70855.

APPENDIX TABLE A-3

Clingstone Peach, Nectarine, and Plum Sales and Allocation by Markets

Marketing Year Beginning June 1	Clingstone peaches						Nectarines		Plums	
	Farm level		Canned							
				Allocation						
	Total sales	Canning allocation	Total pack	U.S. sales	Exports	Stock change	Total sales	Fresh sales	Total sales	Fresh sales
	Q_t^{CP}	Q_p^{CCP}	Q_c^{CP}	Q_d^{CCP}	Q_x^{CCP}	S_Δ^{CCP}	Q_t^N	Q_w^{FN}	Q_t^P	Q_w^{FN}
	X_2	Y_{1D}	Y_{42}	Y_{45}	Y_{24}	Y_{39}	X_4	Y_3	X_5	Y_4
	Thousand tons		Thousand cases				Thousand tons			
1924	134.4	124.8	5206.	4607.	1281.	-682.	0.0	0.0	41.8	40.3
1925	229.6	215.3	9080.	7484.	1856.	-260.	0.0	0.0	53.8	50.8
1926	328.6	317.5	13561.	8599.	1681.	3281.	0.0	0.0	73.8	70.0
1927	254.8	235.4	10499.	10867.	2040.	-2408.	0.0	0.0	57.8	55.5
1928	342.0	322.0	14439.	10490.	2162.	1787.	0.0	0.0	66.8	63.9
1929	178.5	173.3	7724.	7483.	1721.	-1480.	0.0	0.0	39.8	37.8
1930	302.0	288.1	13174.	9257.	1624.	2293.	0.0	0.0	81.8	78.7
1931	201.9	181.5	8349.	5976.	1469.	904.	0.0	0.0	57.7	56.2
1932	174.5	139.4	6414.	8148.	1733.	-3467.	0.0	0.0	57.7	56.5
1933	263.9	233.9	10244.	7415.	1799.	1030.	0.0	0.0	49.7	47.9
1934	264.6	191.3	8258.	7685.	1126.	-553.	0.0	0.0	61.7	59.9
1935	286.6	243.4	10850.	8452.	2305.	93.	0.0	0.0	47.7	45.6
1936	335.7	265.0	10236.	9358.	1309.	-431.	0.0	0.0	63.7	62.4
1937	368.7	322.7	12205.	6854.	1271.	4080.	0.0	0.0	65.7	62.7
1938	290.7	241.8	9446.	10127.	2160.	-2841.	0.0	0.0	62.7	61.7
1939	357.7	299.2	10579.	8673.	1953.	-47.	0.0	0.0	63.7	62.3
1940	336.7	283.2	9608.	11433.	87.	-1911.	0.0	0.0	63.7	62.8
1947	509.7	496.1	15309.	13843.	675.	791.	14.9	13.2	73.7	70.9
1948	498.7	491.3	14650.	12382.	454.	1814.	12.6	12.2	66.7	65.1
1949	479.7	469.4	16525.	17045.	483.	-1003.	16.5	15.6	79.7	77.5
1950	420.7	413.0	14417.	15460.	484.	-1527.	12.3	11.7	74.7	73.1
1951	558.7	552.5	19145.	15828.	430.	2887.	11.8	11.4	93.7	91.0
1952	435.7	429.6	14964.	15540.	514.	-1090.	14.8	14.3	52.7	50.6
1953	515.7	510.6	17163.	15979.	803.	380.	12.8	12.1	76.7	75.0
1954	440.7	434.4	13818.	14998.	970.	-2150.	18.6	17.9	66.7	64.2
1955	516.7	510.8	17923.	15518.	1407.	998.	23.8	23.1	83.7	80.5
1956	572.7	568.4	21322.	15979.	2321.	3022.	18.8	18.4	95.7	91.8
1957	499.0	495.2	18484.	17960.	2621.	-2097.	35.8	35.2	77.7	75.1
1958	473.2	469.2	17545.	14749.	2239.	557.	30.8	29.2	60.7	56.7
1959	556.4	552.7	21485.	18368.	3506.	-389.	38.8	37.6	89.7	85.3
1960	562.4	559.4	21587.	16660.	4133.	793.	43.8	43.0	79.8	76.8
1961	594.9	593.1	22940.	17685.	5316.	-61.	53.8	52.6	84.8	79.9
1962	654.0	650.8	25574.	19322.	6443.	-191.	50.8	49.5	81.8	74.7
1963	687.2	685.0	25089.	21000.	4722.	-633.	56.8	54.8	100.8	95.0
1964	793.0	789.4	30640.	22832.	5175.	2633.	74.8	73.0	110.8	105.0
1965	649.7	647.0	23233.	21007.	4597.	-2371.	64.6	63.5	107.8	102.4
1966	753.9	751.8	30348.	23985.	5100.	1296.	67.8	67.0	85.8	82.2
1967	608.9	608.0	22566.	21578.	2053.	-1065.	54.8	54.1	94.8	90.2
1968	767.2	766.0	29867.	24681.	2600.	2586.	63.8	62.9	105.8	100.5

APPENDIX TABLE A-4

Prices at Grower, Processor, and Auction Markets, 1924-68

Marketing year beginning June 1	Grower returns per ton by utilization										
	Fresh sales				Canning			Drying		Freezing	
	Apricots	Freestone peaches	Nectarines	Plums	Apricots	Clingstone peaches	Freestone peaches	Apricots	Freestone peaches	Apricots	Freestone peaches
	p^{FA}_g	p^{FFP}_g	p^{FN}_g	p^{FP}_g	p^{CA}_g	p^{CCP}_g	p^{CFP}_g	p^{DA}_g	p^{DFP}_g	$p^{Fr.\ A}_g$	$p^{Fr.\ FP}_g$
	Y_5	Y_6	Y_7	Y_8	Y_{16}	Y_{17}	Y_{18}	Y_{19}	Y_{20}	Y_{21}	Y_{22}
	Dollars per ton										
1924	54.	28.	0.	82.	60.	45.	23.	48.	19.	0.	0.
1925	66.	33.	0.	57.	60.	35.	34.	61.	32.	0.	0.
1926	54.	30.	0.	35.	70.	38.	33.	67.	39.	0.	0.
1927	64.	36.	0.	66.	65.	23.	22.	53.	25.	0.	0.
1928	55.	23.	0.	54.	48.	21.	18.	51.	23.	0.	0.
1929	62.	36.	0.	101.	70.	68.	35.	60.	45.	0.	0.
1930	51.	25.	0.	36.	38.	20.	20.	38.	14.	0.	0.
1931	27.	20.	0.	29.	25.	16.	16.	30.	16.	0.	0.
1932	18.	10.	0.	19.	17.	9.	12.	18.	10.	0.	0.
1933	27.	19.	0.	26.	28.	19.	17.	30.	19.	0.	0.
1934	47.	22.	0.	33.	61.	30.	22.	53.	21.	0.	0.
1935	42.	27.	0.	43.	53.	29.	23.	43.	23.	0.	0.
1936	34.	28.	0.	29.	31.	29.	22.	40.	23.	0.	0.
1937	46.	29.	0.	48.	42.	41.	28.	33.	19.	0.	0.
1938	30.	20.	0.	26.	23.	9.	16.	39.	16.	0.	0.
1939	37.	20.	0.	35.	27.	21.	18.	34.	19.	0.	0.
1940	67.	20.	0.	41.	62.	21.	19.	45.	17.	0.	0.
1947	94.	64.	100.	127.	73.	50.	40.	87.	30.	73.	40.
1948	69.	69.	93.	116.	57.	63.	50.	76.	47.	50.	40.
1949	67.	56.	87.	73.	52.	40.	34.	90.	41.	46.	41.
1950	120.	90.	147.	149.	68.	60.	60.	114.	61.	65.	66.
1951	129.	82.	148.	111.	115.	77.	61.	112.	49.	115.	71.
1952	142.	82.	147.	214.	94.	65.	53.	132.	61.	95.	66.
1953	140.	65.	150.	124.	94.	55.	49.	133.	58.	94.	56.
1954	152.	75.	128.	143.	102.	55.	48.	149.	58.	108.	55.
1955	151.	89.	148.	139.	90.	81.	60.	125.	65.	93.	70.
1956	184.	81.	181.	110.	112.	71.	60.	162.	72.	121.	63.
1957	122.	77.	148.	169.	88.	64.	45.	134.	57.	94.	54.
1958	151.	71.	149.	173.	142.	65.	47.	202.	63.	151.	56.
1959	121.	57.	115.	121.	95.	59.	44.	173.	54.	94.	50.
1960	136.	61.	106.	158.	87.	56.	40.	138.	51.	89.	51.
1961	86.	64.	103.	157.	76.	68.	40.	142.	61.	72.	47.
1962	142.	60.	108.	145.	109.	64.	40.	202.	71.	124.	49.
1963	169.	60.	95.	128.	86.	57.	45.	196.	79.	87.	56.
1964	163.	72.	95.	111.	106.	62.	51.	135.	71.	114.	63.
1965	112.	66.	86.	101.	78.	64.	68.	139.	54.	78.	47.
1966	209.	104.	142.	189.	86.	68.	51.	176.	65.	91.	61.
1967	237.	120.	158.	176.	132.	83.	73.	200.	70.	125.	90.
1968	220.	113.	148.	186.	152.	76.	77.	249.	111.	152.	83.

Marketing year beginning June 1	Processor f.o.b. prices							Eastern Auction Market prices for fresh fruit			
	Canned			Dried		Frozen					
	Apricots	Clingstone peaches	Freestone peaches	Apricots	Freestone peaches	Apricots	Freestone peaches	Apricots	Freestone peaches	Nectarines	Plums
	$p^{CA}_{f.o.b.}$	$p^{CCP}_{f.o.b.}$	$p^{CFP}_{f.o.b.}$	$p^{DA}_{f.o.b.}$	$p^{DFP}_{f.o.b.}$	$p^{Fr.\ A}_{f.o.b.}$	$p^{Fr.\ FP}_{f.o.b.}$	p^{FA}_w	p^{FFP}_w	p^{FN}_w	p^{FP}_w
	Y_{27}	Y_{28}	Y_{29}	Y_{30}	Y_{31}	Y_{32}	Y_{33}	Y_{34}	Y_{35}	Y_{36}	Y_{37}
	Dollars per case			Cents per pound				Dollars per lug			Dollars per crate
1924	4.60	4.72	4.30	18.3	10.0	0.0	0.0	1.54	0.95	0.00	1.99
1925	4.40	4.23	3.80	20.7	13.8	0.0	0.0	1.64	1.05	0.00	1.73
1926	4.55	4.10	4.00	22.9	12.5	0.0	0.0	1.60	1.01	0.00	1.45
1927	4.65	3.45	3.50	17.5	9.4	0.0	0.0	1.76	1.17	0.00	1.81
1928	4.35	3.50	3.30	18.9	8.4	0.0	0.0	1.45	0.86	0.00	1.67
1929	4.65	4.57	4.40	19.9	14.5	0.0	0.0	1.60	1.01	0.00	2.37
1930	4.00	3.20	3.20	13.5	6.8	0.0	0.0	1.52	0.93	0.00	1.44
1931	3.25	2.80	3.00	9.8	6.8	0.0	0.0	1.42	0.83	0.00	1.39
1932	2.75	2.15	2.80	7.6	4.7	0.0	0.0	1.24	0.65	0.00	1.25
1933	3.00	2.49	2.90	11.2	7.7	0.0	0.0	1.38	0.79	0.00	1.32
1934	4.15	2.88	4.00	18.5	8.7	0.0	0.0	1.42	0.83	0.00	1.36
1935	3.25	2.66	3.80	16.0	9.0	0.0	0.0	1.36	1.31	0.00	1.55
1936	3.10	2.79	3.80	14.0	8.7	0.0	0.0	1.43	1.22	0.00	1.36
1937	3.30	3.11	3.80	11.6	7.3	0.0	0.0	1.68	1.14	0.00	1.69
1938	2.75	2.44	3.70	15.1	6.9	0.0	0.0	1.38	1.10	0.00	1.34
1939	3.40	2.56	3.60	12.0	8.1	0.0	0.0	1.67	0.94	0.00	1.50
1940	3.80	2.43	3.60	15.5	6.5	0.0	0.0	1.95	1.03	0.00	1.58
1947	6.00	4.78	6.50	29.0	13.5	11.0	10.5	2.56	2.26	2.80	3.65
1948	5.25	5.10	7.00	29.3	18.4	10.5	12.9	2.53	2.20	2.10	3.49
1949	5.00	4.07	5.90	29.9	17.0	12.0	11.2	2.64	2.21	2.67	2.88
1950	5.75	5.17	7.50	37.2	24.1	14.3	13.3	3.69	2.34	4.21	4.02
1951	5.94	5.53	7.50	39.3	23.6	16.1	15.1	3.56	3.14	4.46	3.28
1952	5.68	5.32	7.00	47.7	25.9	13.6	12.9	4.24	2.37	4.01	5.44
1953	5.25	5.12	6.70	43.3	26.5	12.2	11.4	3.52	2.55	4.99	4.04
1954	5.66	5.17	6.45	49.4	24.1	14.5	12.3	4.20	2.45	4.29	4.65
1955	5.10	5.70	6.78	44.6	28.5	14.0	14.2	4.18	3.20	4.30	3.97
1956	5.60	5.35	6.29	58.2	31.7	12.1	12.9	4.34	2.62	4.74	3.55
1957	5.48	5.10	6.10	50.2	28.6	13.9	12.9	3.90	2.62	3.45	4.76
1958	6.75	5.36	6.16	75.8	30.2	14.5	14.8	4.16	2.68	3.87	4.73
1959	5.38	4.89	5.79	62.5	31.1	14.7	11.7	4.53	2.44	3.36	3.86
1960	5.24	4.86	5.52	53.5	26.3	14.8	11.8	3.68	2.95	3.09	4.58
1961	4.95	4.70	5.37	71.7	35.0	14.1	15.4	3.45	2.57	3.03	4.83
1962	5.65	4.50	5.20	51.4	31.6	14.5	13.1	4.45	2.62	3.19	4.33
1963	5.30	4.87	6.00	71.0	37.6	14.1	13.6	4.27	2.66	3.05	4.03
1964	5.26	4.51	5.68	59.4	36.6	14.0	13.6	5.19	3.04	3.04	3.70
1965	4.90	4.65	5.80	56.9	35.0	14.5	13.7	4.69	2.86	2.96	3.51
1966	5.15	4.63	6.00	64.9	38.8	17.3	14.2	4.86	3.19	3.83	5.71
1967	6.55	5.50	7.15	78.2	45.6	21.0	16.0	5.41	3.61	3.76	5.56
1968	6.70	5.30	7.10	80.6	51.0	-0.0	-0.0	5.71	3.40	3.90	5.56

Description and Sources of Endogenous Variables

$Y_1 = Q_w^{FA}$ = Quantity of California apricots sold for fresh use, in and out of state, in thousand tons. Source: California Crop and Livestock Reporting Service [1956], [1968], and [1969].

$Y_2 = Q_w^{FFP}$ = Quantity of California freestone peaches sold for fresh use in and out of state, in thousand tons. Source: see Y_1.

$Y_3 = Q_w^{FN}$ = Quantity of California nectarines sold for fresh use in and out of state, in thousand tons. Source: see Y_1.

$Y_4 = Q_w^{FP}$ = Quantity of California plums sold for fresh use in and out of state, in thousand tons. Source: see Y_1.

$Y_5 = P_g^{FA}$ = Grower price of California apricots sold for fresh use, dollars per ton. Source: see Y_1.

$Y_6 = P_g^{FFP}$ = Grower price of California freestone peaches sold for fresh use, dollars per ton. Source: see Y_1.

$Y_7 = P_g^{FN}$ = Grower price of California nectarines sold for fresh use, dollars per ton. Source: see Y_1.

$Y_8 = P_g^{FP}$ = Grower price of California plums sold for fresh use, dollars per ton. Source: see Y_1.

$Y_9 = Q_p^{CA}$ = Quantity of California apricots sold for canning, in thousand tons. Source: see Y_1.

$Y_{10} = Q_p^{CCP}$ = Quantity of California clingstone peaches sold for canning, in thousand tons. Source: see Y_1.

$Y_{11} = Q_p^{CFP}$ = Quantity of California freestone peaches sold for canning, in thousand tons. Source: see Y_1.

$Y_{12} = Q_p^{DA}$ = Quantity of California apricots utilized in drying, in thousand tons. Source: see Y_1.

$Y_{13} = Q_p^{DFP}$ = Quantity of California freestone peaches utilized in drying, in thousand tons. Source: see Y_1.

$Y_{14} = Q_p^{\text{Fr. A}}$ = Quantity of California apricots sold for freezing, in thousand tons. Source: see Y_1.

$Y_{15} = Q_p^{\text{Fr. FP}}$ = Quantity of California freestone peaches sold for freezing, in thousand tons. Source: see Y_1.

$Y_{16} = P_g^{CA}$ = Grower price of California apricots sold for canning, dollars per ton. Source: see Y_1.

$Y_{17} = P_g^{CCP}$ = Grower price of California clingstone peaches sold for canning, dollars per ton. Source: see Y_1.

$Y_{18} = P_g^{CFP}$ = Grower price of California freestone peaches sold for canning, dollars per ton. Source: see Y_1.

$Y_{19} = P_g^{DA}$ = Grower price of California apricots utilized in drying, dollars per ton. Source: see Y_1.

$Y_{20} = P_g^{DFP}$ = Grower price of California freestone peaches utilized in drying, dollars per ton. Source: see Y_1.

$Y_{21} = P_g^{\text{Fr. A}}$ = Grower price of California apricots sold for freezing, dollars per ton. Source: see Y_1.

$Y_{22} = P_g^{\text{Fr. FP}}$ = Grower price of California freestone peaches sold for freezing, dollars per ton. Source: See Y_1.

$Y_{23} = Q_x^{CA}$ = Quantity exported of California canned apricots, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$Y_{24} = Q_x^{CCP}$ = Quantity exported of California canned clingstone peaches, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$Y_{25} = Q_x^{DA}$ = Quantity exported of California dried apricots, thousands of tons (includes "dried" and "dried in fruit salad"). Sources: Shear and Blair [1958]; and U.S. Department of Agriculture [1969].

$Y_{26} = Q_x^{DFP}$ = Quantity exported of California dried freestone peaches, thousands of tons (inludes "dried" and "dried in fruit salad"). Sources: Shear and Blair [1958]; and U.S. Department of Agriculture [1969].

$Y_{27} = P^{CA}_{f.o.b.}$ = Canner f.o.b. price of California canned apricots, dollars per case, 24 No. 2-1/2 choice. Source: Hoos and Kuznets [1969].

$Y_{28} = P^{CCP}_{f.o.b.}$ = Canner f.o.b. price of California canned clingstone peaches, dollars per case, 24 No. 2-1/2 choice. Source: Hoos and Kuznets [1969].

$Y_{29} = P^{CFP}_{f.o.b.}$ = Canner f.o.b. price of California canned freestone peaches, dollars per case, 24 No. 2-1/2 fancy. Source: Hoos and Kuznets [1969].

$Y_{30} = P^{DA}_{f.o.b.}$ = Packer f.o.b. price of California dried apricots, extra choice Blenheims, cents per pound. Simple averages of July 1 to December 31 weekly quotations of packer prices, f.o.b. California. Source: *Pacific Fruit News* [1969].

$Y_{31} = P^{DFP}_{f.o.b.}$ = Packer f.o.b. price of California dried freestone peaches, cents per pound. Simple averages of August 1 to December 31 weekly quotations of packer prices, f.o.b. California choice unpeeled Muirs or Yellow peaches in 25-pound boxes. Source: *Pacific Fruit News* [1969].

$Y_{32} = P^{Fr.\ A}_{f.o.b.}$ = Freezer f.o.b. price of California frozen apricots, cents per pound of bulk choice Blenheims. Simple averages of monthly quotations for the marketing year, July 1 to June 30. Sources: *Quick Frozen Foods* [1955]; *The Canner and Freezer* [1960]; and *Canner/Packer,* Western Edition [1969].

$Y_{33} = P^{Fr.\ FP}_{f.o.b.}$ = Freezer f.o.b. price of California frozen freestone peaches, cents per pound of bulk choice Elbertas. Series construction and data sources are the same as for Y_{32}.

$Y_{34} = P_w^{FA}$ = Average price of California apricots in Eastern auction markets, dollars per Brentwood lug for Royals. Sources: *Federal-State Market News Service* [1969a]; and Foytik [1959].

$Y_{35} = P_w^{FFP}$ = Average price of California freestone peaches in Eastern auction markets, dollars per lug. Sources: Keller, Shear, and Alcorn [1941]; and *Federal-State Market News Service* [1969c].

$Y_{36} = P_w^{FN}$ = Average price of California nectarines in Eastern auction markets, dollars per lug. Source: *Federal-State Market News Service* [1969b].

$Y_{37} = P_w^{FP}$ = Average price of California plums in Eastern auction markets, dollars per crate. Sources: *Federal-State Market News Service* [1969d]; and Foytik [1968].

$Y_{38} = S_{\Delta}^{CA}$ = Change in canners' stocks of California canned apricots, thousands of cases, 24 No. 2-1/2 basis. Source of stock data: Hoos and Kuznets [1969].

$Y_{39} = S_{\Delta}^{CCP}$ = Change in canners' stocks of California canned clingstone peaches, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$Y_{40} = S_{\Delta}^{CFP}$ = Change in canners' stocks of California canned freestone peaches, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$Y_{41} = Q_c^{A}$ = Total annual pack of California canned apricots, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$Y_{42} = Q_c^{CP}$ = Total annual pack of California clingstone peaches, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$Y_{43} = Q_c^{FP}$ = Total annual pack of California canned freestone peaches, thousands of cases, 24 No. 2-1/2 basis. Sources: Konijn, Shear, and Hoos [1956]; and Hoos and Kuznets [1969].

$Y_{44} = Q_d^{CA}$ = Canners' f.o.b. commercial domestic movement plus U.S. government direct f.o.b. purchases of California canned apricots, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$Y_{45} = Q_d^{CCP}$ = Canners' f.o.b. commercial domestic movement plus U.S. government direct f.o.b. purchases of California canned clingstone peaches, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$Y_{46} = Q_d^{CFP}$ = Canners' f.o.b. commercial domestic movement of California canned freestone peaches, thousands of cases, 24 No. 2-1/2 basis. Sources: Konijn, Shear, and Hoos [1956]; and Hoos and Kuznets [1969].

$Y_{47} = Q_d^{DA}$ = Packers' f.o.b. commercial domestic movement of California dried apricots, thousands of tons. Source: U.S. Department of Agriculture [1969].

$Y_{48} = Q_d^{DFP}$ = Packers' f.o.b. commercial domestic movement of California dried freestone peaches, thousands of tons. Source: U.S. Department of Agriculture [1969].

$Y_{49} = Q_d^{Fr.\ A}$ = Freezers' f.o.b. commercial domestic movement of California frozen apricots, thousands of pounds. Series was constructed by adjusting the total frozen pack for stock changes. Sources: pack statistics, National Association of Frozen Food Packers [1969]; and data on stocks from U.S. Statistical Reporting Service [1969b].

$Y_{50} = Q_d^{Fr.\ FP}$ = Freezers' f.o.b. commercial domestic movement of California frozen freestone peaches, thousands of pounds. Series construction and data sources are the same as for Y_{49}.

APPENDIX TABLE A-5

Exogenous Variables X_6--X_{18}, 1924-68

Marketing year beginning June 1	Freestone peach sales other than California	Time trend	Disposable income	Transportation cost	Processing cost	Beginning stocks					Foreign production		Margin
						Canned			Frozen				
						Apricots	Clingstone peaches	Freestone peaches	Apricots	Freestone peaches	Apricots	Peaches	
	Q^{FFP}_{wr}	T	D	C_t	C_p	S^{CA}_b	S^{CCP}_b	S^{CFP}_c	$S^{Fr.\ A}_b$	$S^{Fr.\ FP}_b$	Q^{FA}_t	Q^{FP}_t	M
	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}
	Thousand tons	Years	Index	Dollars per hour		Thousand cases							Index
1924	914.3	1.	37.5	73.	0.82	298.	1391.	184.	0.	0.	178.5	2058.5	127.9
1925	702.4	2.	40.4	73.	0.79	315.	709.	89.	0.	0.	183.5	1985.9	136.7
1926	1057.4	3.	40.7	73.	0.78	21.	449.	125.	0.	0.	188.5	1913.3	154.9
1927	555.4	4.	40.7	73.	0.77	401.	3730.	176.	0.	0.	194.0	1840.7	138.4
1928	967.5	5.	43.3	71.	0.79	952.	1322.	193.	0.	0.	199.0	1768.1	115.9
1929	752.6	6.	42.7	71.	0.79	154.	3109.	40.	0.	0.	204.0	1695.5	123.6
1930	531.4	7.	36.8	72.	0.73	1189.	1629.	54.	0.	0.	209.2	1622.9	142.3
1931	1268.3	8.	29.6	72.	0.64	546.	3922.	29.	0.	0.	194.1	1896.0	120.0
1932	508.6	9.	23.6	72.	0.55	515.	4826.	19.	0.	0.	227.1	1141.0	121.3
1933	555.4	10.	26.3	68.	0.55	323.	1359.	2.	0.	0.	228.5	1233.0	134.2
1934	651.4	11.	28.8	67.	0.66	167.	2389.	2.	0.	0.	261.9	1282.0	119.5
1935	885.5	12.	32.9	66.	0.67	227.	1836.	21.	0.	0.	231.0	1497.0	81.7
1936	699.1	13.	37.0	65.	0.68	844.	1929.	112.	0.	0.	221.1	1164.0	89.4
1937	865.1	14.	36.0	64.	0.78	228.	1498.	69.	0.	0.	244.8	1112.4	87.9
1938	784.1	15.	35.8	67.	0.72	2305.	5578.	435.	0.	0.	249.7	1040.2	87.2
1939	938.3	16.	38.5	66.	0.68	528.	2737.	269.	0.	0.	254.5	965.5	93.5
1940	802.9	17.	43.8	66.	0.70	479.	2690.	273.	0.	0.	260.4	893.0	94.8
1947	1042.2	24.	94.8	73.	1.22	279.	456.	41.	4427.	6409.	322.0	937.2	86.7
1948	731.7	25.	101.9	84.	1.34	639.	1247.	248.	4854.	5558.	311.7	765.9	82.6
1949	815.1	26.	103.3	87.	1.37	1508.	3061.	265.	2197.	2146.	433.5	996.8	92.8
1950	503.0	27.	115.7	89.	1.38	532.	2058.	271.	435.	882.	371.6	951.1	85.3
1951	666.0	28.	123.2	89.	1.49	115.	531.	52.	586.	952.	416.0	1391.9	83.5
1952	772.4	29.	131.0	94.	1.56	614.	3418.	374.	1127.	1320.	422.7	1242.7	94.0
1953	749.4	30.	134.6	95.	1.51	646.	2328.	465.	741.	1837.	458.6	1358.1	94.6
1954	729.0	31.	139.5	95.	1.52	1021.	2708.	397.	603.	3001.	428.2	1350.3	92.7
1955	427.8	32.	151.1	95.	1.56	222.	558.	340.	673.	1368.	348.5	1423.1	97.3
1956	728.9	33.	160.0	98.	1.57	1777.	1557.	322.	4588.	3790.	314.0	1206.2	102.1
1957	668.0	34.	165.8	103.	1.63	993.	4579.	1076.	1786.	4918.	475.0	1742.8	98.1
1958	922.7	35.	174.7	101.	1.62	604.	2482.	960.	1639.	6265.	413.1	1606.2	99.9
1959	847.1	36.	182.6	96.	1.65	117.	3039.	869.	2323.	5244.	490.7	2124.4	102.0
1960	873.6	37.	188.2	94.	1.67	581.	2650.	1617.	1769.	3232.	380.4	2189.9	103.8
1961	853.5	38.	199.5	95.	1.65	1766.	3443.	1558.	4228.	8683.	715.0	2614.3	104.0
1962	704.1	39.	208.9	94.	1.61	1179.	3382.	1399.	3598.	10117.	589.9	2551.2	105.2
1963	692.0	40.	222.8	93.	1.71	1013.	3191.	1128.	3182.	6666.	676.0	3085.0	103.2
1964	497.7	41.	239.0	93.	1.52	625.	2558.	1103.	3611.	4379.	604.0	3377.0	105.7
1965	635.5	42.	259.6	93.	1.57	1210.	5191.	1988.	5062.	14387.	627.0	3211.0	105.0
1966	574.4	43.	277.1	93.	1.57	1115.	2820.	1236.	5625.	9657.	573.0	3317.3	104.9
1967	432.6	44.	298.1	94.	1.59	1020.	4116.	1068.	4959.	7095.	700.0	3190.0	101.9
1968	679.4	45.	322.1	94.	1.65	970.	3051.	962.	2097.	8120.	786.0	3943.0	101.1

Description and Sources of Exogenous Variables

$X_1 = Q_t^A$ = Total quantity of California apricots sold in all outlets such as canning, drying, freezing, and fresh, thousands of tons. Sources: California Crop and Livestock Reporting Service [1956], [1968], and [1969].

$X_2 = Q_t^{CP}$ = Total quantity of California clingstone peaches sold in all outlets such as canning, freezing, drying, and fresh, thousands of tons. Source: see X_1.

$X_3 = Q_t^{FP}$ = Total quantity of California freestone peaches sold in all outlets such as canning, drying, freezing, and fresh, thousands of tons. Source: see X_1.

$X_4 = Q_t^N$ = Total quantity of California nectarines sold in all outlets, thousands of tons. Source: see X_1.

$X_5 = Q_t^P$ = Total quantity of California plums sold in all outlets, thousands of tons. Source: See X_1.

$X_6 = Q_{wr}^{FFP}$ = Total quantity of freestone peaches sold in the United States excluding California, thousands of tons. Sources: Hoos and Fuller [1955]; and U.S. Statistical Reporting Service [1969].

$X_7 = T$ = Time trend, in years, beginning with marketing year 1924 = 1.

$X_8 = D$ = Index of United States disposable personal income, 1947-48 to 1949-50 = 100. Source: Hoos and Kuznets [1969].

$X_9 = C_t$ = Cost of transportation: index (1957-59 = 100) of railroad freight rates for fruits and vegetables in the United States. Source: U.S. Economic Research Service [1968].

$X_{10} = C_p$ = Cost efficiency of labor: average hourly earnings of production workers in "canned, cured, and frozen foods industry" divided by the index of output per man-hour in "all food manufacturing" with a base period of 1957-59 = 100. Data on hourly earnings from the U.S. Bureau of Labor Statistics [1967] for 1935 to date and partially estimated for previous years. Data on output per man-hour from Economic Research Service [1969] for 1947 to date; for previous years, based on Waldorf [1961].

$X_{11} = S_b^{CA}$ = Canners' stocks of California canned apricots on hand at the beginning of marketing year, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$X_{12} = S_b^{CCP}$ = Canners' stocks of California canned clingstone peaches on hand at the beginning of marketing year, thousands of cases, 24 No. 2-1/2 basis. Source: Hoos and Kuznets [1969].

$X_{13} = S_b^{CFP}$ = Canners' stocks of California canned freestone peaches on hand at the beginning of marketing year, thousands of cases, 24 No. 2-1/2 basis. Sources: Konijn, Shear, and Hoos [1956]; and Hoos and Kuznets [1969].

$X_{14} = S_b^{Fr.\ A}$ = Packers' stocks of Pacific frozen apricots on hand at the beginning of marketing year, June 1, thousands of pounds. The data were obtained from U.S. Statistical Reporting Service [1969b].

$X_{15} = S_b^{Fr.\ FP}$ = Packers' stocks of Pacific frozen freestone peaches on hand at the beginning of marketing year, July 1, thousands of pounds. Source: U.S. Statistical Reporting Service [1969b].

$X_{16} = Q_t^{FA}$ = Total foreign production of apricots, thousands of tons. Sources: U.S. Bureau of Agricultural Economics [1938]; and U.S. Department of Agriculture [1969].

$X_{17} = Q_t^{FP}$ = Total foreign production of peaches, thousands of tons. Sources: U.S. Bureau of Agricultural Economics [1938]; and U.S. Department of Agriculture [1969].

$X_{18} = M$ = Index (1957-59 = 100) of marketing margin or price spread between the f.o.b. wholesale and retail levels for processed fruits. The series was constructed by taking the ratio of the retail to wholesale (f.o.b.) price indexes of processed fruits and then transferring the ratio into index form. Source: U.S. Bureau of Labor Statistics [1969].

APPENDIX B

TABLE 8-1

Reduced-Form Matrix of Coefficients

Exogenous variables	Endogenous variables																								
	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9	Y_{10}	Y_{11}	Y_{12}	Y_{13}	Y_{14}	Y_{15}	Y_{16}	Y_{17}	Y_{18}	Y_{19}	Y_{20}	Y_{21}	Y_{22}	Y_{23}	Y_{24}	Y_{25}
Constant	15.67505	80.14570	0.76900	2.61334	-197.92003	-164.62800	-276.98211	-155.08692	-101.06338	-80.99937	-149.90328	90.98121	100.40190	-6.13579	-81.79026	-4.13723	-28.02129	-82.05700	-78.00003	-60.08791	-87.23899	48.71979	721.35924	859.50424	51.31382
X_1	0.04115	-0.03472	-0.00010	0.00003	-0.00050	0.00298	0.00118	-0.00326	0.27412	0.02500	0.03003	0.67480	-0.02000	0.00227	0.02473	-0.13091	0.02714	0.04038	-0.08323	0.03213	-0.00364	-0.02233	0.00484	-0.62276	0.00373
X_2	0.00022	0.01107	0.00000	-0.00000	-0.00282	-0.00300	-0.00091	0.00598	-0.00346	0.93980	-0.61513	0.00349	0.00790	-0.00023	-0.00359	-0.00290	-0.06952	-0.02339	0.00000	-0.00117	-0.00086	0.00338	0.16004	2.93422	0.00000
X_3	-0.00227	0.10032	0.00003	-0.00101	-0.03038	-0.06364	-0.02293	0.09936	-0.02331	-0.04366	0.21701	0.02931	0.52162	-0.00422	0.00206	0.01352	-0.04719	-0.03870	0.07112	-0.08400	0.06331	-0.07237	0.00170	1.73402	0.00420
X_4	-0.00237	-0.27418	0.98860	0.00112	-0.00204	-0.36076	-1.03036	-0.18992	-0.14317	-0.06776	0.27172	0.20073	0.01656	-0.02376	0.03443	0.07142	-0.07536	-0.06776	-0.02499	0.00331	0.13943	-0.07359	0.00672	2.58061	0.00190
X_5	0.00027	-0.00900	0.00013	0.95002	-0.00346	-0.17348	-0.07670	-1.00281	-0.00114	-0.01920	0.00032	0.00136	0.00031	-0.00029	0.00252	0.00128	-0.01621	-0.01304	-0.00011	-0.00003	0.00281	-0.00420	0.03981	0.62373	0.00002
X_6	-0.00012	-0.01240	0.00004	0.00019	-0.04149	-0.02500	-0.01822	-0.01882	-0.00088	-0.00300	0.01216	0.00966	0.00079	-0.00114	0.00102	0.00342	-0.00333	-0.00311	-0.00118	0.00026	0.00000	-0.00338	0.00376	0.11700	0.00009
X_7	0.10702	1.90028	-0.01005	0.03080	-0.00076	-0.43341	1.92676	-0.65495	1.23938	-0.63793	0.04595	-1.79322	-2.71118	0.21139	0.01614	-1.10597	0.18343	-0.04892	0.23980	-0.39563	-0.18251	1.21242	-6.06467	79.64026	0.16582
X_8	-0.32146	-70.32470	-0.27086	-1.00298	196.13777	169.75292	135.43103	184.48299	63.00367	39.31363	52.97322	-84.39267	-63.77396	6.53719	52.69513	23.63166	42.60118	76.72343	52.61041	31.33582	-14.04741	-72.93396	-123.03863	-1701.00003	-12.91038
X_9	0.00000	0.03405	-0.00075	-0.00100	0.00986	0.07718	2.37332	0.10096	0.00961	0.00783	-0.03651	-0.01314	-0.00118	0.00159	-0.00304	-0.00488	0.00063	0.00744	0.00160	-0.00035	-0.01383	0.00583	-0.01408	-0.31532	-0.00012
X_{10}	0.01352	62.43123	0.01310	-0.33329	-15.91120	-20.39618	-6.34973	32.87138	9.98059	33.92732	11.16356	6.49712	-41.35733	-4.78998	-27.34548	80.76482	36.03369	-0.70343	59.32986	24.22939	117.20436	109.33771	-137.98148	-1005.29366	-9.74236
X_{11}	0.00423	-0.00292	-0.00001	-0.00000	-0.00624	-0.00626	0.00319	0.00000	-0.02364	-0.00236	-0.00218	0.02198	0.00212	-0.00274	0.00243	-0.01010	-0.00236	-0.00366	-0.00263	0.00053	0.02111	-0.00712	0.01700	0.12942	0.00021
X_{12}	-0.00000	-0.00006	-0.00000	0.00000	0.00001	0.00001	0.00000	-0.00002	0.00001	-0.00379	0.00006	-0.00001	-0.00003	0.00000	0.00001	0.00001	-0.00412	0.00011	-0.00000	0.00300	0.00000	-0.00001	0.00030	0.13656	-0.00000
X_{13}	-0.00023	0.00414	0.00000	-0.00002	-0.00034	-0.00166	-0.00070	0.00200	0.00038	0.00104	-0.00522	-0.00034	0.00263	0.00011	-0.00143	-0.00029	0.00113	-0.00998	0.00042	-0.00043	-0.00136	0.00172	-0.00222	-0.00193	0.00002
X_{14}	-0.00113	0.00273	0.00000	-0.00001	0.00127	-0.00232	-0.00168	0.00103	0.00391	0.00042	0.00022	-0.00373	-0.00117	0.00078	-0.00154	-0.00187	0.00045	0.00063	0.00032	0.00004	-0.01031	0.00060	0.00100	-0.01134	-0.00004
X_{15}	0.00028	-0.00365	-0.00000	0.00002	0.00034	0.00156	0.00871	-0.00132	-0.00000	-0.00018	0.00039	0.00892	0.00130	-0.00019	0.03178	0.00044	-0.00018	-0.00022	0.00008	-0.00018	0.00233	-0.00532	-0.00003	0.00404	0.00002
X_{16}	0.00000	-0.00000	0.00000	0.00000	-0.00000	0.00000	0.00000	-0.00000	-0.00000	-0.00000	0.00000	0.00000	0.00000	-0.00000	0.00000	0.00000	-0.00000	0.00000	-0.00000	0.00000	0.30000	-0.00000	-0.30213	-0.02379	0.00086
X_{17}	-0.00000	0.00000	-0.00000	-0.00000	-0.00000	0.00000	-0.00000	0.00000	0.00000	0.00000	-0.00000	-0.00000	-0.00000	0.00000	-0.00000	-0.00000	0.00000	-0.00000	0.00000	-0.00000	-0.00000	0.00000	0.10062	1.04234	0.00163
X_{18}	-0.00000	0.00000	0.00000	0.00000	0.00000	-0.00000	-0.00000	0.00000	0.00000	0.00000	-0.00000	-0.00000	-0.00000	0.00000	-0.00000	-0.00000	0.00000	-0.00000	0.00000	-0.00000	-0.00000	0.00000	0.00000	0.00000	-0.00000

Exogenous variables	Endogenous variables																								
	Y_{26}	Y_{27}	Y_{28}	Y_{29}	Y_{30}	Y_{31}	Y_{32}	Y_{33}	Y_{34}	Y_{35}	Y_{36}	Y_{37}	Y_{38}	Y_{39}	Y_{40}	Y_{41}	Y_{42}	Y_{43}	Y_{44}	Y_{45}	Y_{46}	Y_{47}	Y_{48}	Y_{49}	Y_{50}
Constant	9.21675	1.00024	-0.52782	-0.21018	-32.20715	-23.36166	-12.00169	10.02641	-3.36393	-3.79180	-18.62902	-2.69586	-7921.38148	-12919.75760	6007.26447	-18900.38166	-70804.61426	13038.21106	-11799.27942	-88946.45117	9058.54633	29.96615	56.81726	-23000.24097	-113065.95603
X_1	0.00064	-0.00059	0.00192	0.00464	-0.03728	0.01378	-0.00050	-0.00479	-0.00114	0.00152	0.00143	-0.00007	7.19762	0.24947	-2.78926	17.33299	3.10500	-7.26902	10.27058	3.48700	-6.47876	0.02738	-0.02017	0.81737	8.24926
X_2	0.00000	-0.00012	-0.00493	-0.00332	0.00027	-0.00057	-0.00001	0.00072	-0.00005	-0.00000	-0.00003	0.00012	-1.08631	3.61839	-0.24986	-2.76260	29.82267	-2.23137	-1.03695	18.03800	-2.00232	-0.00030	0.00061	-0.87734	-1.26426
X_3	0.00231	0.00038	-0.00333	-0.00464	0.02764	-0.04136	0.00063	-0.01536	-0.00075	-0.00138	-0.00006	0.00202	-2.24246	3.09661	1.41778	-5.60510	11.22981	2.79878	-3.45436	3.36118	1.38180	-0.04026	0.04313	-2.00008	28.08096
X_4	0.00000	0.00303	-0.00322	-0.00778	-0.00963	0.00261	0.02599	-0.01621	-0.01635	-0.01369	-0.05252	-0.00224	-3.81089	3.03363	2.01708	-14.38353	12.77928	0.67653	-0.77135	3.14313	3.63963	0.00616	-0.00573	-12.43764	52.50998
X_5	0.00000	0.00000	-0.00117	-0.00130	-0.00000	-0.00001	0.00033	-0.00000	-0.00007	-0.00617	-0.00218	-0.04033	-0.62398	1.42936	0.64229	-1.37138	6.24190	0.02522	-0.91003	2.10860	0.38293	0.00001	0.00001	-0.19200	1.67786
X_6	0.00001	0.00013	-0.00024	-0.00036	-0.00046	0.00012	0.00124	-0.00077	-0.00079	-0.00060	-0.00052	-0.00038	-0.27751	0.22638	0.14022	-0.68489	0.36648	0.31204	-0.41114	0.22231	0.17182	0.00030	-0.00018	-0.39600	1.00070
X_7	0.03671	-0.00278	-0.02276	-0.02718	0.04599	-0.06217	0.01063	0.00945	0.03063	0.01159	0.05765	0.01363	-5.00203	-78.08923	65.21600	12.36196	-218.26696	103.61204	24.46868	-220.09793	120.39798	0.21647	0.17988	262.96218	711.40729
X_8	-3.54604	1.00507	3.02605	0.00987	20.98337	25.20812	-1.91947	-13.53458	3.72062	2.40302	2.84442	2.75468	6112.45028	8891.77295	-6400.74860	15592.69116	47364.44331	-10047.39570	9004.29944	48204.27832	-8440.84747	-0.38562	-18.80027	17900.67336	82381.04688
X_9	-0.00002	-0.00021	0.00001	0.00005	0.00062	-0.00016	-0.00178	0.00123	0.00186	0.00186	0.06762	0.00212	8.34616	-0.66367	-0.29811	1.20057	-1.82761	-0.62306	0.79449	-0.05042	-0.32696	-0.00040	0.00024	0.04004	-2.53951
X_{10}	-2.43000	2.64005	2.61224	-0.00077	22.22198	11.09813	16.01681	22.44448	-0.26390	-0.47549	-0.10592	0.66057	-2044.11316	-8389.67174	1687.29839	-6060.76294	-24830.11230	5567.23474	-2858.66827	-10795.36402	3879.82637	-2.87612	-9.31436	-11400.02964	-57019.02031
X_{11}	0.00002	-0.00043	-0.00018	-0.00042	-0.00104	0.00026	0.00208	-0.00132	-0.00012	0.00013	0.00012	0.00000	-0.99293	0.12313	0.13423	-0.65316	0.19914	0.33138	0.32267	-0.05243	0.17736	0.00005	-0.00038	-1.41749	5.24932
X_{12}	-0.00008	0.00000	-0.00029	0.00001	-0.00000	0.00000	0.00000	-0.00000	0.00000	0.00000	0.00000	-0.00000	0.01072	-0.63980	-0.13914	0.02720	1.20018	-0.32273	0.00717	1.74042	-0.26259	0.00000	-0.00000	0.00031	0.00000
X_{13}	0.00001	-0.00001	0.00008	-0.00113	0.00017	-0.00022	-0.00021	0.00037	-0.00001	-0.00000	-0.00002	0.00004	-0.44136	-1.13740	-0.46497	-1.11644	-5.21218	0.97840	-0.67468	-4.01277	1.44337	-0.00022	0.00024	0.87602	-0.60365
X_{14}	-0.00001	-0.00000	0.00003	0.00007	0.00013	0.00002	-0.00141	0.00000	0.00002	-0.00006	-0.00003	0.00002	0.10001	-0.08224	-0.04131	0.29638	0.05549	-0.10604	0.13022	0.08927	-0.06534	-0.00003	-0.00001	0.00402	-2.00085
X_{15}	0.00001	0.00002	-0.00001	-0.00002	0.00003	-0.00009	0.00033	-0.00116	0.00001	0.00006	0.00002	-0.00004	-0.02732	0.00629	0.01196	-0.00743	0.01030	0.02986	-0.03964	-0.00402	0.01709	-0.00007	0.00009	-0.00304	2.00977
X_{16}	0.00123	-0.00000	-0.00000	0.00000	-0.00000	0.00000	0.00000	-0.00000	0.00000	0.00000	0.00000	-0.05000	-0.19731	-0.22638	-0.00000	-0.49966	-1.05237	-0.00000	0.00000	0.00000	-0.00000	0.00000	0.00000	-0.00000	0.00000
X_{17}	0.00054	0.00000	0.00000	-0.00000	0.00000	-0.00000	-0.00000	0.00000	-0.00000	-0.00000	-0.00000	0.00000	0.07167	0.50534	0.00000	0.18138	2.36809	0.00000	-0.00000	-0.00000	0.00000	-0.00000	0.00000	0.00000	-0.00000
X_{18}	-0.00000	0.00000	0.00000	-0.00000	0.00000	-0.00000	-0.00000	0.00000	0.00000	-0.00000	-0.00000	0.00000	4.08313	17.00505	-3.24103	10.32923	76.97373	-10.74043	6.24610	61.97070	-7.51940	-0.00460	0.08578	44.62820	240.19608

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